NASA National Aeronautics and Space Administration

1983 Safety Program Data Report

NASA Safety Division
Office of the Chief Engineer
Washington, D. C. 20546

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SAFETY PROGRAM - 1983 OVERVIEW

NASA maintains an excellent Safety and Health record, evidence of management's commitment to the safety program. The number of accidents and resultant monetary loss was the lowest in recent NASA history. Many tangible and intangible efforts contributed to this superb record. Although we cannot measure all the things which prevent accidents, some highlights are presented in this report. A major achievement was that the rate of Continuation-of-Pay (COP) cases, which is an indirect measure of the rate of lost-time injuries occurring, dropped in 1983 to 0.64 per 200,000 man-hours worked, compared with 0.71 in 1982. This compares with the lost-time rates reported on OSHA form 102F of 0.47 in 1982 and 0.41 in 1983. The definitions used for these two rates are slightly different; thus the apparent discrepancy.

The reduction of injuries in the workplace is an issue presently receiving national attention. President Reagan and Mr. Donovan, the Secretary of Labor, have called for a 3 percent per year reduction in compensation claim injuries over the next 5 years, which the NASA Administrator has heartily endorsed. Mr. Beggs has called on each center to support meeting this goal, and reduction quotas have been established. Many installation directors are getting personally involved, conducting walkthroughs, and discussing safety issues with employees. Beginning with FY 1984, the Department of Labor will utilize only Office of Workman's Compensation Program (OWCP) data to evaluate federal agency safety programs.

Haggai Cohen
Deputy Chief Engineer

SAFETY ACTIVITIES

In 1983, NASA continued its numerous activities and programs to improve safety.

To demonstrate the high visibility and importance of safety within NASA, a letter and poster were signed by the Administrator and distributed to the field to convey his personal support of the NASA Safety Program. Several agency goals and objectives were established for 1983, and a Safety Program Plan was distributed to the centers. This plan described the major objectives and milestones planned by the Safety Division for the year. Quantitative goals for each center were established which could be used as safety program performance indicators for NASA and contractor employee lost-time rates as well as Type A and B mishaps and monetary losses.

Several meetings were held throughout the year to promote awareness. A joint Safety, Reliability, and Quality Assurance (SR&QA), and Occupational Health meeting was held at NSTL in October. The first Aviation Safety Officer's meeting was held at the Army Safety Center in Fort Rucker, Alabama, in April. Headquarters-sponsored courses were held throughout the year on such subjects as System Safety, Principles of Ergonomics, NFPA Life Safety Code, and Accident Investigation. In addition to the Headquarters-sponsored training, centers sponsored courses with particular value to their personnel. Among the course topics were materials handling, confined entry, propellant handling, and fire safety. A similar menu of courses is planned for 1984.

Fire risk assessments were conducted by Factory Mutual at JPL, NSTL, and GSFC (TDRSS-WSTF) facilities. This activity continued into 1984. NASA responded to the results of these assessments with increased fire safety awareness and activity at all centers.

Headquarters continues to perform an oversight role by conducting SR&QA surveys of the center operations. Reviews at LaRC, LeRC, GSFC, and JPL were completed. In addition, independent aviation safety reviews of the flight operations at ARC/DFRF, LaRC, and JSC were conducted.

Mishap investigation and analysis activities have been ongoing. A noteworthy accomplishment toward establishing a NASA Mishap Data Base is that summaries of reports for 1968-1979 are now accessible through NASA's Scientific and Technical Information Facility (STIF) using on-line computer terminals and the RECON system. Copies of the reports are available off-line as microfiche and hardcopy. A total of seven Investigation Board reports were closed out by completing actions and disseminating lessons learned.

NASA strongly supports the national campaign to increase safety belt usage and improve motor vehicle safety. Promotional material, films, and a Seat Belt Audiovisual and Resource Kit were distributed to the centers. A briefing was made to center safety directors and a progress report was presented to NASA senior management to heighten program visibility.

NASA has worked strongly to improve accident investigation policies and procedures, and a NASA handbook, "Guidelines for Mishaps Investigation," was published. Approximately sixty people were trained in these new policies. An aircraft accident investigator's checklist and recommendations for an investigator's kit were distributed to the centers.

NASA has initiated a Safety Engineering Training Program. An agreement was negotiated with the Department of the Army to participate in the Safety Engineering Intern Program at Red River Depot, Texarkana, Texas, and a recent college graduate sponsored by the Lewis Research Center was enrolled in the one year program.

In 1984, the NASA Safety Program will continue to strive for increased safety awareness by developing new policies for fire protection engineering, system safety, facilities integrity, laboratory safety, explosive safety, and construction safety; continuing fire risk assessments at Ames Research Center and Marshall Space Flight Center; and developing new safety training courses tailored to NASA programs and activities. Efforts will continue to focus on effective use of accident board reports and incidents for lessons learned. Headquarters survey activities will continue to provide an oversight of the strengths and weaknesses of center safety programs. Safety research efforts will continue toward the development of an automated NASA Mishap Reporting and Corrective Action System, Life Safety Code Equivalency Concept, and the Full-Scale Testing of Condensation Nuclei Fire Detector System. The FY84 Safety Program Plan, Objectives, and Goals will be published and distributed to the field.

Safety also is an integral part of the agency's new initiative to enhance quality and improve productivity. The effort to improve quality is at the same time an effort to improve safety within NASA. In 1983 NASA implemented an employee suggestion program which enables employees to exhibit their initiative and serves to open communication channels between employees and management. Prompt evaluation of all suggestions is required, with cash awards for the most valuable comments. 1983 also saw the large-scale implementation of NASA Employee Teams (quality circles) by NASA and NASA contractors. The teams are trained in problem solving techniques, and the top team for the year is selected for recognition.

Table 9, at the end of this report, shows the number of safety personnel employed at each facility. It is followed by a comprehensive list of all safety related training courses and programs held during 1983.

HEALTH ACTIVITIES

There were many activities related to health. The NASA Occupational Health Office adopted the International Classification of Disease, 9th Edition (ICD-9), in medical records and accident reports. The standardization of diagnostic codes used by DOD and most hospitals will simplify computerization of medical and environmental health records.

Three issues of an "Occupational Health Alerts and Information Exchange" were prepared and distributed. They contained health items from individual installations for the benefit of others. The issues were well received and much feedback was generated.

Health awareness and education continued with many employee screening efforts and training sessions. One of these was for hypertension in conjunction with the national effort in May 1983. Continuing education for professional staff was monitored at all installations and was found to be exemplary. All NASA installations continued their job recertification physical examinations and health maintenance examinations. Participation in the latter was so high (70-90 percent) that compliance with job-related examinations was virtually complete. All installations have experienced increased employee participation in the Agency Physical Fitness Program. Some facilities were opened/enlarged during CY83. Six Occupational Health Bulletins were written and distributed to all employees. They discussed Carbon Monoxide, Hand Protection, Safety Belts, Heat Stress, Video Display Terminals, and Midlife Transition. As part of the Safety Belt emphasis, physicians gave illustrated lectures on the value of wearing a safety belt and included counsel during annual medical examinations on their use. At one installation safety belt usage increased from 23 percent to 42 percent. All installations experienced increased seat belt usage.

A policy was established for hazard assessment and abatement of asbestos in NASA buildings. A comprehensive policy involving the coordination of Environmental Health, Medicine, and Facilities activities was developed to deal with the presence, use, and handling of asbestos. Extensive efforts have been made at all installations to implement policy requirements. Laboratories at Lewis Research Center and Johnson Space Center provided analytical support.

An agency standard on confined space entry was developed and published. It is being implemented at all NASA installations. The standard was reviewed by OSHA. Scripts for two training videotapes on this subject, to be made in 1984, were prepared.

An annual Occupational Medicine, Environmental Health, and Safety Meeting was held at National Space Technology Laboratories. The meeting was certified for 11 credit hours of AMA Category I (CME) for physicians and 2½ ABIH Certification Maintenance Credits for industrial hygienists.

Occupational health training was emphasized and included two sessions of the J.T. Baker course on handling hazardous chemicals.

NASA disposed of PCB wastes in conformity with EPA requirements. A LeRC laboratory provided valuable support to other installations in PCB analysis. A NASA PCB Risk Assessment Manual was developed by the Facilities Office and is being followed.

Inventories of hazardous materials were initiated, and several centers have completed these. Hazardous Material Data Sheets are being obtained and several centers are utilizing Automated Data Processing (ADP) systems for the provision of toxic and hazardous chemical information.

Emphasis was continued on the Hearing Conservation Program, with considerable progress being made towards implementation of the NASA Management Instruction on Hearing Conservation. Annual audiograms are given to many employees at NASA installations. Other required measures are being instituted.

Increased emphasis was placed on preventive health activities such as review and health approval of engineering drawings, purchase requests, contracts, and work orders.

In 1984, the NASA Health Program will continue to strive for increased health awareness through education, training, and audits, including the following specific goals:

- complete the inventory of hazardous materials; identify and monitor non-spray applied installation of asbestos at centers;
- review center hearing conservation measures for completeness;
- review job-related medical examinations and records; reduce occupational injury and illness cases by 3 percent for FY84;
- continue stressing seat belt use; reduce absenteeism; and improve the general health of NASA employees through increased nutritional awareness, smoking cessation, and improved physical fitness;
- review health provisions for handicapped workers;
- computerize "Health Information Management System" (HIMS) using the Kennedy Space Center as lead center for development.

OCCUPATIONAL INJURY/ILLNESS
1983 STATISTICS

Fatalities	:	0
Non lost-time workday injuries	:	156
Lost workday injuries	:	86
Lost wages	:	$ 149,422
Chargeback billing	:	$5,254,080

For reporting purposes, illnesses and injuries to personnel are divided into two classes: lost-time and non lost-time. Lost-time injuries/illnesses are defined by OSHA as work related injuries/illnesses which involve days away from work, or days of restricted activity, or both. The number of days away from work or days of restricted work activity does not include the day of injury or onset of illness, or any days on which the employee would not have worked even though able to work.

LOST TIME INJURIES

Two statistics are normally generated as a measure of lost-time. The number of lost-time injuries/illnesses per 200,000 hours is a gross figure which gives an indication of how many lost-time incidents were reported in relation to the number of hours worked. This rate has been steadily declining for NASA in recent years, and in 1983 it dropped to 0.41 from the 1982 figure of 0.47. Table 1 shows injury/illness statistics for all centers during 1983.

TABLE 1. NASA INJURY/ILLNESS DATA BY INSTALLATION -- ANNUAL 1983

	NO. OF EMPLOYEES	HOURS WORKED IN(K)	TOTAL INJURY/ ILLNESS DATA			LOST-TIME INJURY/ILLNESS DATA					LOST-TIME RATE OBJECTIVE FOR 1983	
			NO. CASES	FREQ. RATE 1982	FREQ. RATE 1983	NO. CASES	NO. DAYS	FREQ. RATE. 1982	FREQ. RATE. 1983	SEVERITY RATE	CUM. RATE	TARGET RATE
ARC	2198	4,349	16	0.66	0.74	7	36	0.13	0.32	1.66	0.32	0.30
GSFC	3795	7,316	34	1.45	0.93	17	258	0.84	0.46	7.05	0.45	0.60
HQ	1657	2,992	24	2.47	1.60	8	48	1.07	0.53	3.21	0.53	0.50
JSC	3606	6,171	72	2.23	2.33	12	163	0.30	0.39	5.28	0.39	0.30
KSC	2227	4,883	12	0.52	0.49	7	263	0.34	0.29	10.77	0.29	0.30
LaRC	2996	5,359	16	1.21	0.60	7	92	0.45	0.26	3.43	0.26	0.40
LeRC	2621	4,755	54	2.30	2.27	20	169	0.71	0.84	7.11	0.84	0.60
MSFC	3349	5,272	13	0.61	0.41	7	201	0.19	0.22	6.41	0.22	0.30
NSTL	127	264	1	0	0.76	1	1	0	0.76	0.76	0.76	0
TOTAL	22,576	42,360	242	1.40	1.14	86	1,231	0.47	0.41	5.81	0.41	
LAST YEAR	22,862	41,904	293	1.40	---	99	881	0.47	---	4.20	0.47	

1. Total injury/illness frequency rate = number of cases per 200,000 hours worked.

2. Lost-time injury/illness frequency rate = number of lost workday cases per 200,000 hours worked.

3. Injury/illness severity rate = number of lost workdays per 200,000 hours worked.

Within the Federal Government in 1982, NASA ranked second lowest in the frequency rate of injuries/illnesses among major Federal agencies. Figure 1 illustrates the relative position of the NASA frequency rate compared to other Federal agencies for CY 1982. Comparable figures for 1983 will not be available until next year.

Figure 2 plots the NASA lost-time injury/illness rate for the last 11 years against the overall Federal Government rate and selected private sector rates. NASA has consistently maintained a rate well below that of the Federal Government average and the average rate in the private sector. Figure 3 compares the injury rates at the individual facilities to the all NASA lost-time injury rate.

A second measure of lost-time is the injury severity rate, which measures the number of days lost per 200,000 hours worked. This figure is of particular interest because compensation for lost wages as opposed to medical costs constitutes the bulk of injury compensation costs. The severity rate did increase slightly from 4.20 in 1982 to 5.81 days lost per 200,000 hours worked in 1983. Figure 4 shows a consistent decline since 1976 in the injury severity rate, except for 1983, and compares the severity rates at the individual facilities to the all NASA rate. The decline in the all NASA rate is attributed to aggressive efforts by NASA to reduce accidents, and to reduce days lost by offering appropriate light duty. Efforts should be renewed to reverse the small increase noted in 1983.

Figure 5 shows how NASA has compared enviably with other organizations in terms of time lost due to occupational injuries/illnesses.

The information in Table 2 is derived from NASA Form 345, the Accident Cause Analysis Report. Form 345 is completed for reportable injuries/illnesses to NASA civil and contractor employees. The forms are compiled and information is generated on the number of injuries to different parts of the body.

Table 2 illustrates this information for lost-time injuries. For NASA and contractor employees combined, the greatest percentage of injuries is to the back, and most often caused by falls or during lifting. Injuries to the leg are the second most frequent type of injury. However, for NASA employees, the most frequent injury is to the abdomen, followed by the leg and foot.

CY 1982 LOST TIME INJURY/ILLNESS RATES IN FEDERAL AGENCIES

OCCUPATIONAL INJURY & ILLNESS INCIDENCE RATES FOR CIVILIAN PERSONNEL PER 200,000 MAN-HOURS WORKED

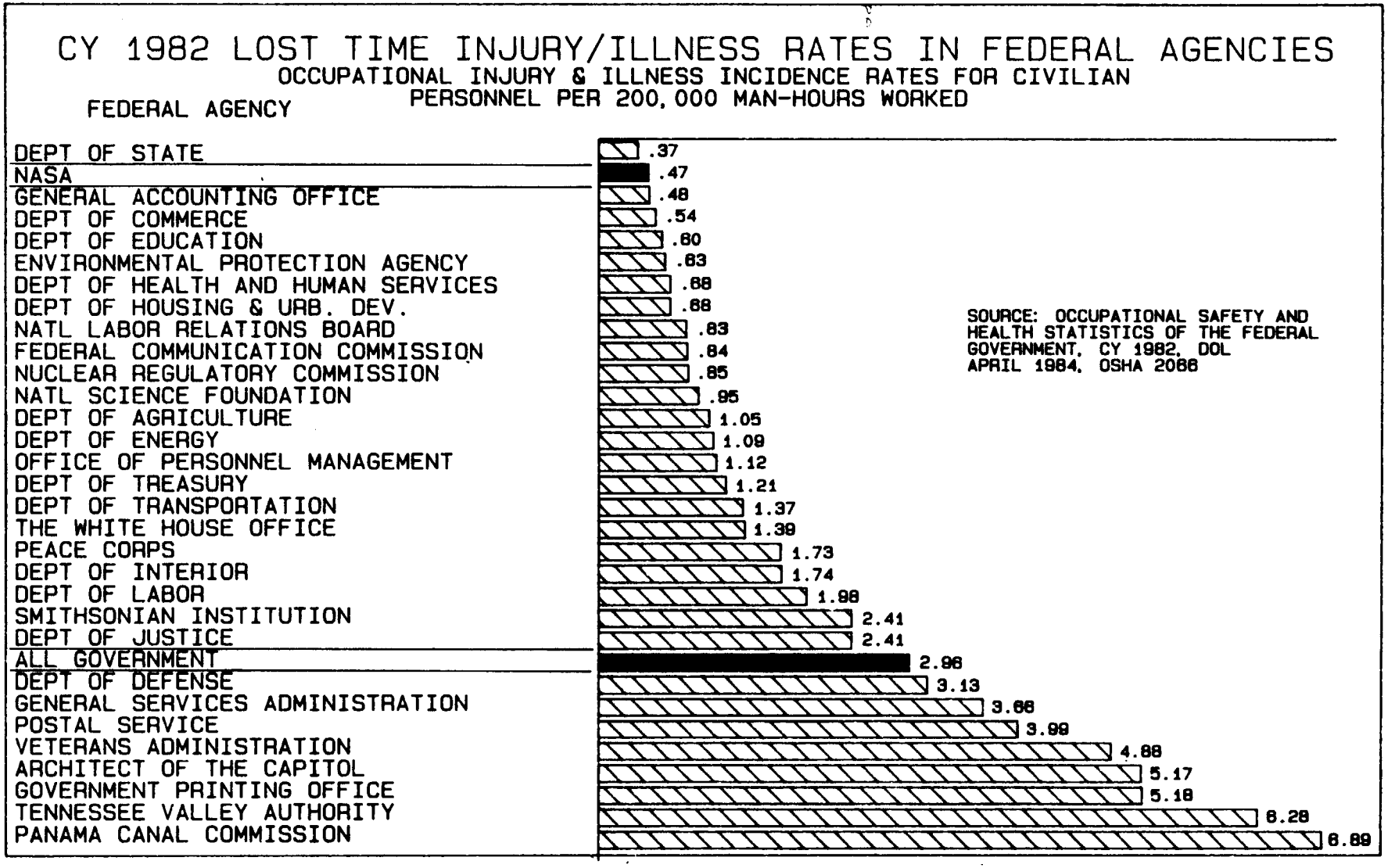


Figure 1
6

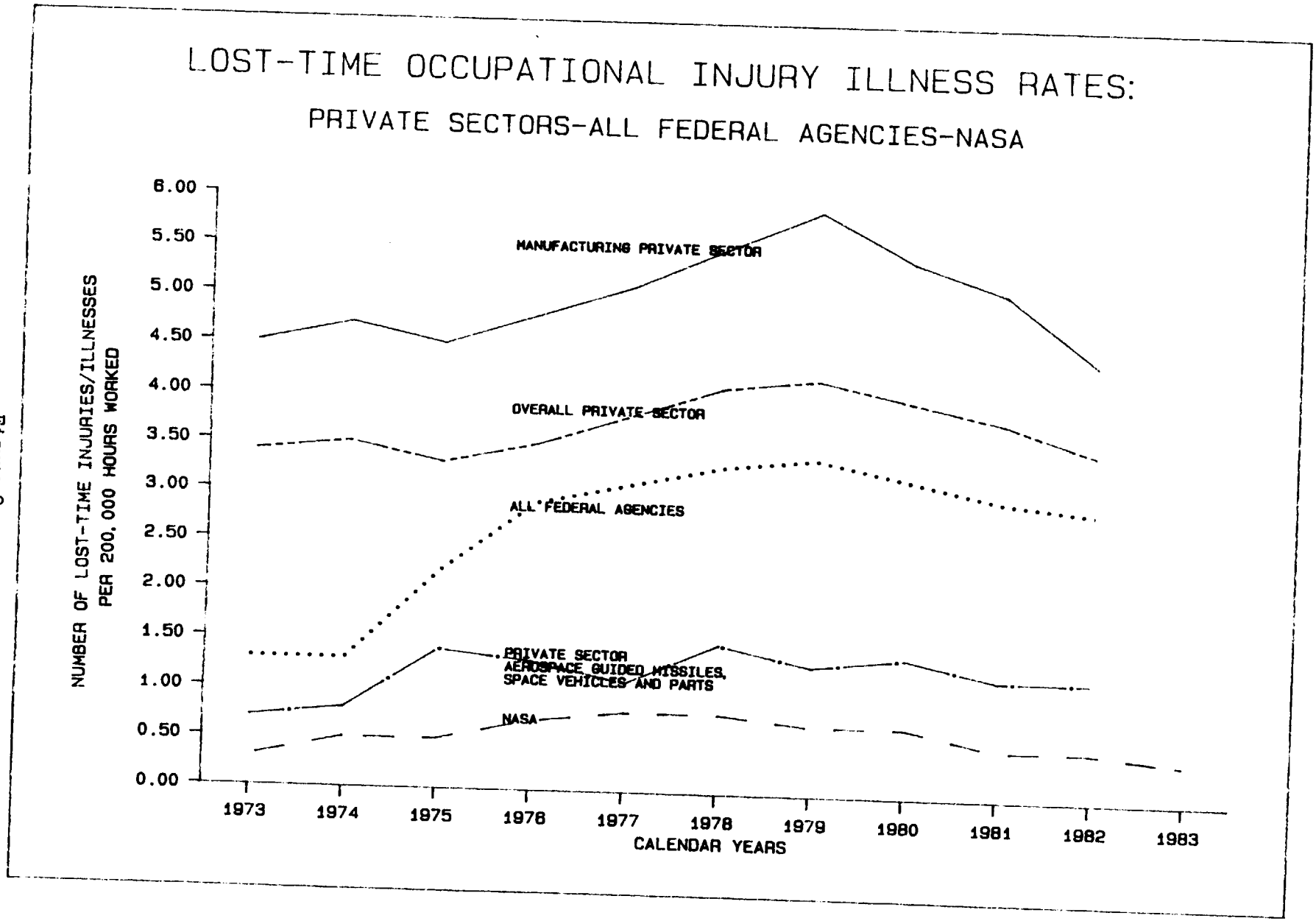

LOST-TIME OCCUPATIONAL INJURY ILLNESS RATES:
PRIVATE SECTORS-ALL FEDERAL AGENCIES-NASA
NUMBER OF LOST-TIME INJURIES/ILLNESSES PER 200,000 HOURS WORKED
6.00
5.50
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
MANUFACTURING PRIVATE SECTOR
OVERALL PRIVATE SECTOR
ALL FEDERAL AGENCIES
PRIVATE SECTOR AEROSPACE GUIDED MISSILES, SPACE VEHICLES AND PARTS
NASA
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
CALENDAR YEARS

Figure 2

INJURY FREQUENCY RATES

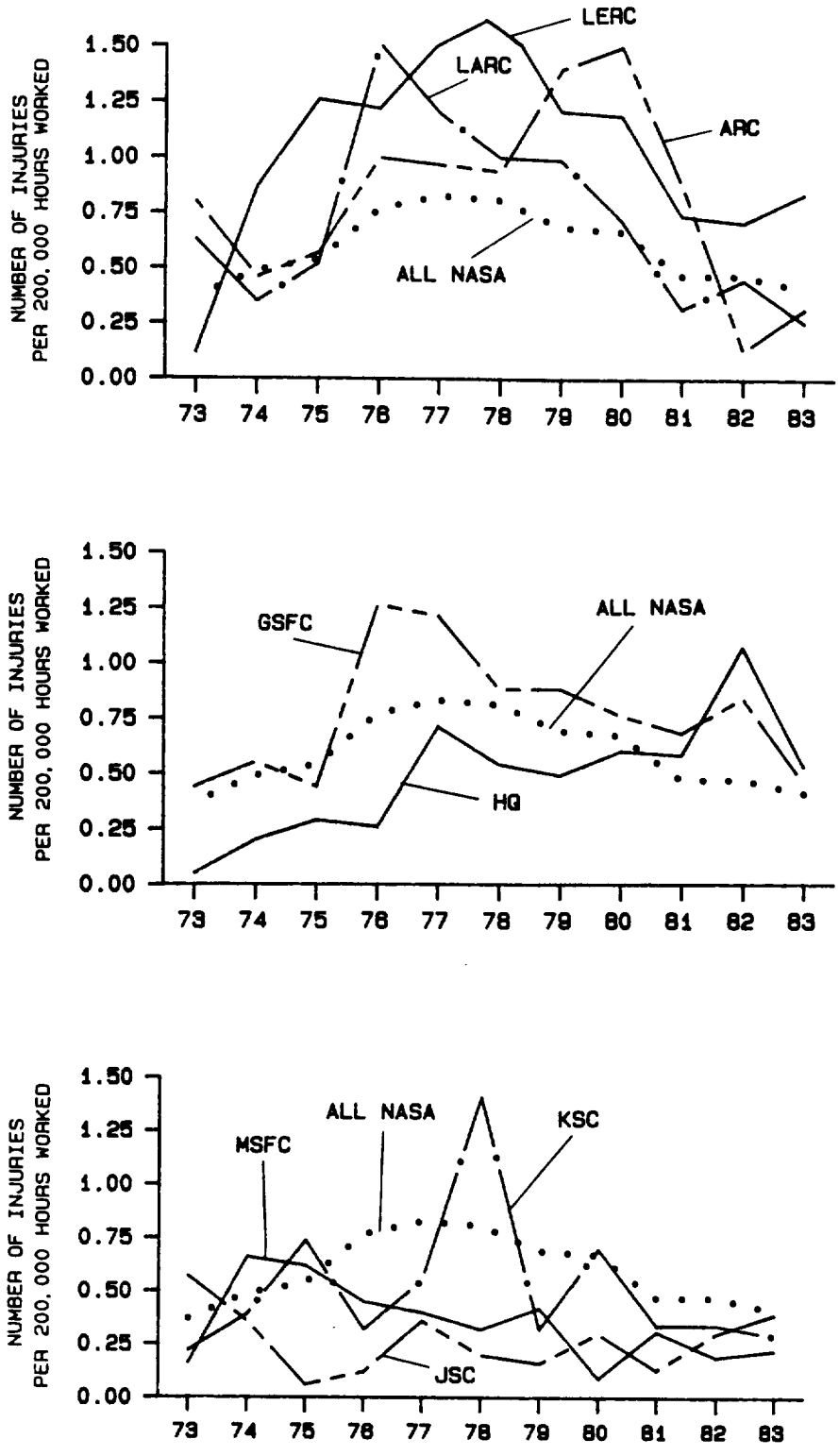
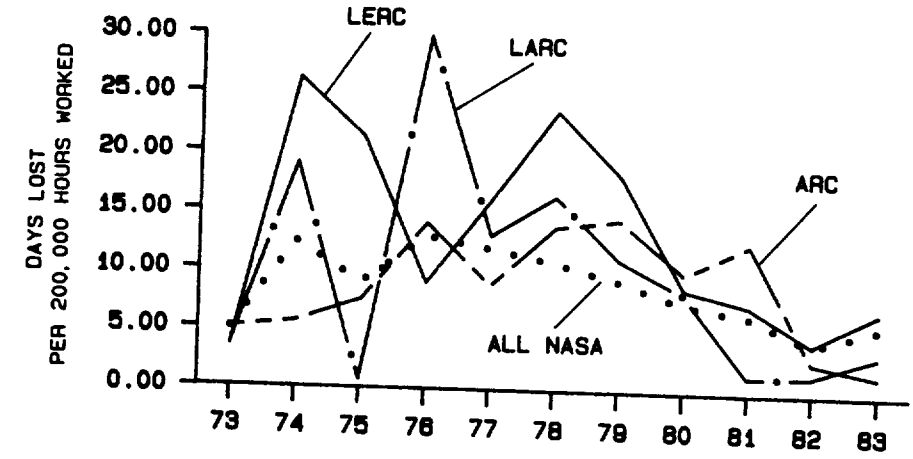
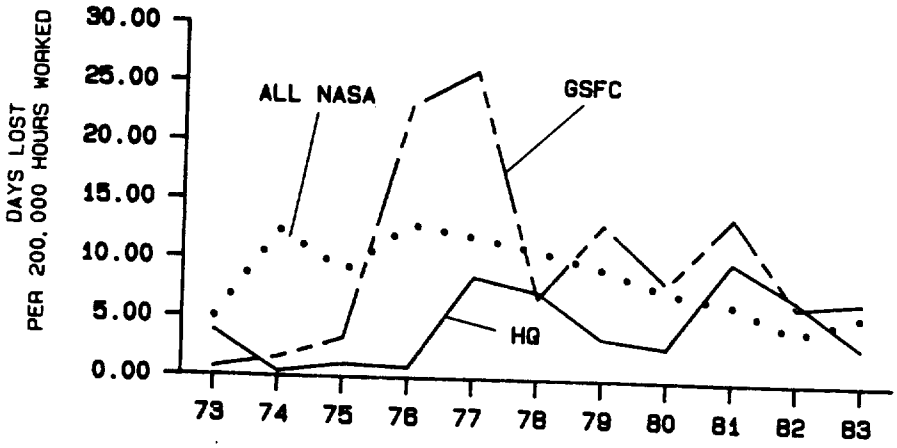


Figure 3

INJURY SEVERITY RATES





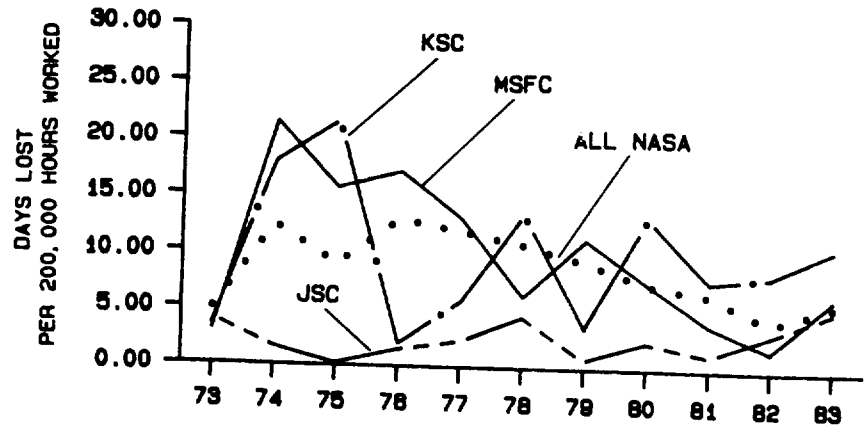


Figure 4

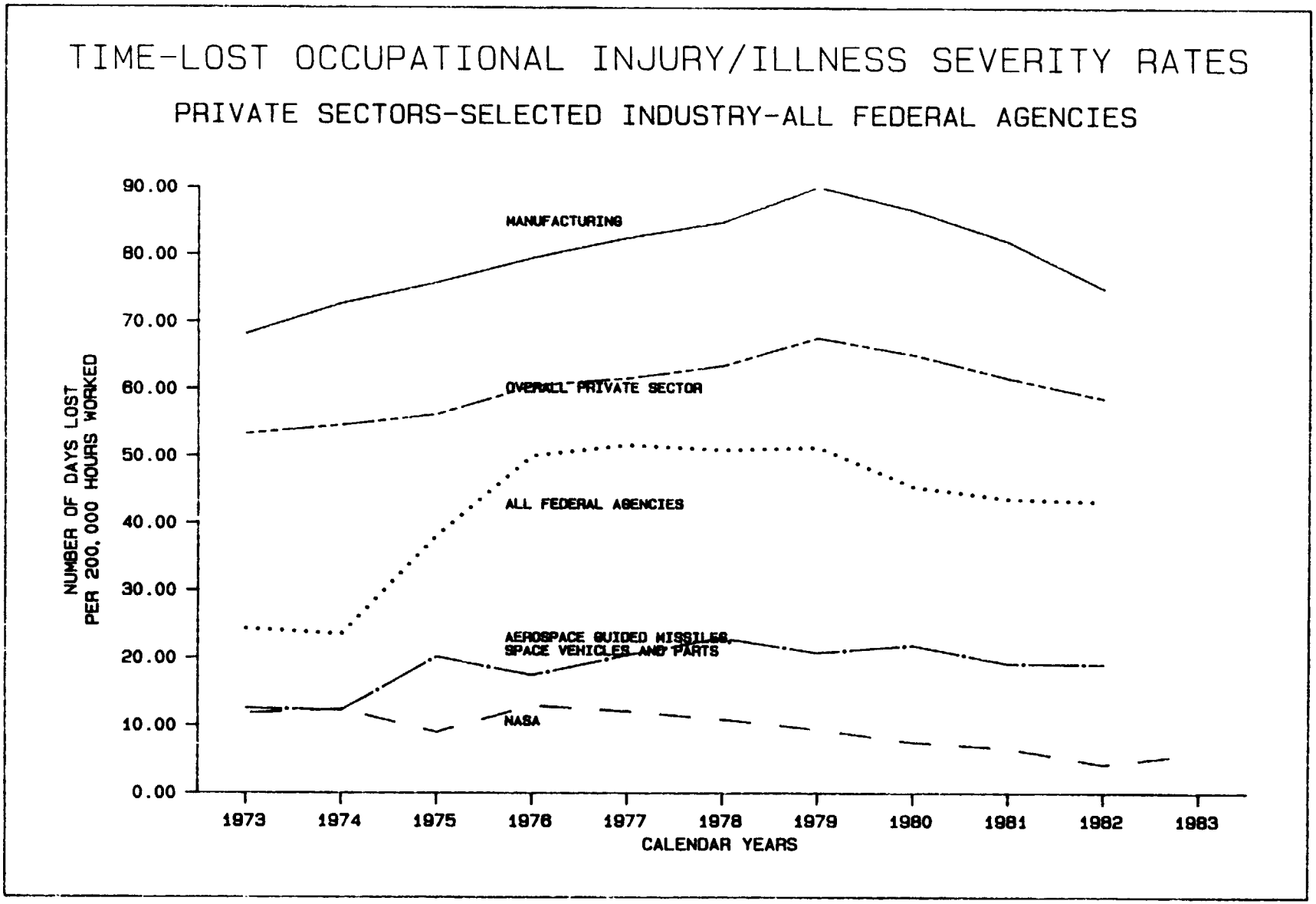

TIME-LOST OCCUPATIONAL INJURY/ILLNESS SEVERITY RATES
PRIVATE SECTORS-SELECTED INDUSTRY-ALL FEDERAL AGENCIES
NUMBER OF DAYS LOST PER 200,000 HOURS WORKED
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
MANUFACTURING
OVERALL PRIVATE SECTOR
ALL FEDERAL AGENCIES
AEROSPACE GUIDED MISSILES, SPACE VEHICLES AND PARTS
NASA
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
CALENDAR YEARS

Figure 5
13

TABLE 2. PART OF BODY INJURED

PERCENTAGES SHOWN ARE OF TOTAL LOST TIME

	NASA EMPLOYEES		CONTRACTORS	
	NO. OF INJURIES	%	NO. OF INJURIES	%
HEAD	8	8	11	5
EYE	4	4	8	4
FACE	6	6	3	1
BACK	5	5	71	31
CHEST	2	2	3	1
ARM	6	6	14	6
TORSO	1	1	15	6
ABDOMEN	28	28	8	4
HAND	5	5	19	8
FINGERS	1	1	13	6
LEG	17	17	34	15
FOOT	10	10	14	6
TOE	2	2	5	2
OTHER	4	4	10	4
TOTAL	99		228	

NON LOST-TIME INJURIES

Non lost-time injuries and illnesses are defined as those injuries/illnesses which require medical treatment, but for which there are no work days lost or no restriction of work beyond the day of the injury. If only first aid was required, the accident/injury is not recordable and not included in non lost-time statistics. Regardless of medical treatment, if the injury/illness involved loss of consciousness, restriction of work or motion, transfer to another job, or termination of employment, it becomes recordable either as a non lost-time or a lost-time injury/illness.

Figure 6 plots the lost-time rate, the non lost-time rate, and the total reportable rate (lost-time plus non lost-time) per 200,000 hours work. The 1983 total reportable rate of 1.14 represents a decline from 1.4 for 1982 and the lowest rate since records have been kept.

Figure 7 shows how the total of reportable injury/illness rates has varied over the last 11 years compared with other organizations. NASA's rate shows a commendable decline in this period.

Table 3 shows, by center, the number of lost-time cases as reported to OSHA, and the number as reported to OWCP. The difference includes cases being controverted, cases where less than one day is lost beyond the date of injury, aggravation of previous injuries, and similar circumstances which are counted differently by two organizations.

Table 4 compares, by Center, the CY 1983 injury/illness cases and rates for NASA federal employees with the same data reported for on-site contractors. The all-NASA contractor rate of 1.00 is more than double the rate of 0.41 for federal employees, but is comparable to similar work performed in the private sector.

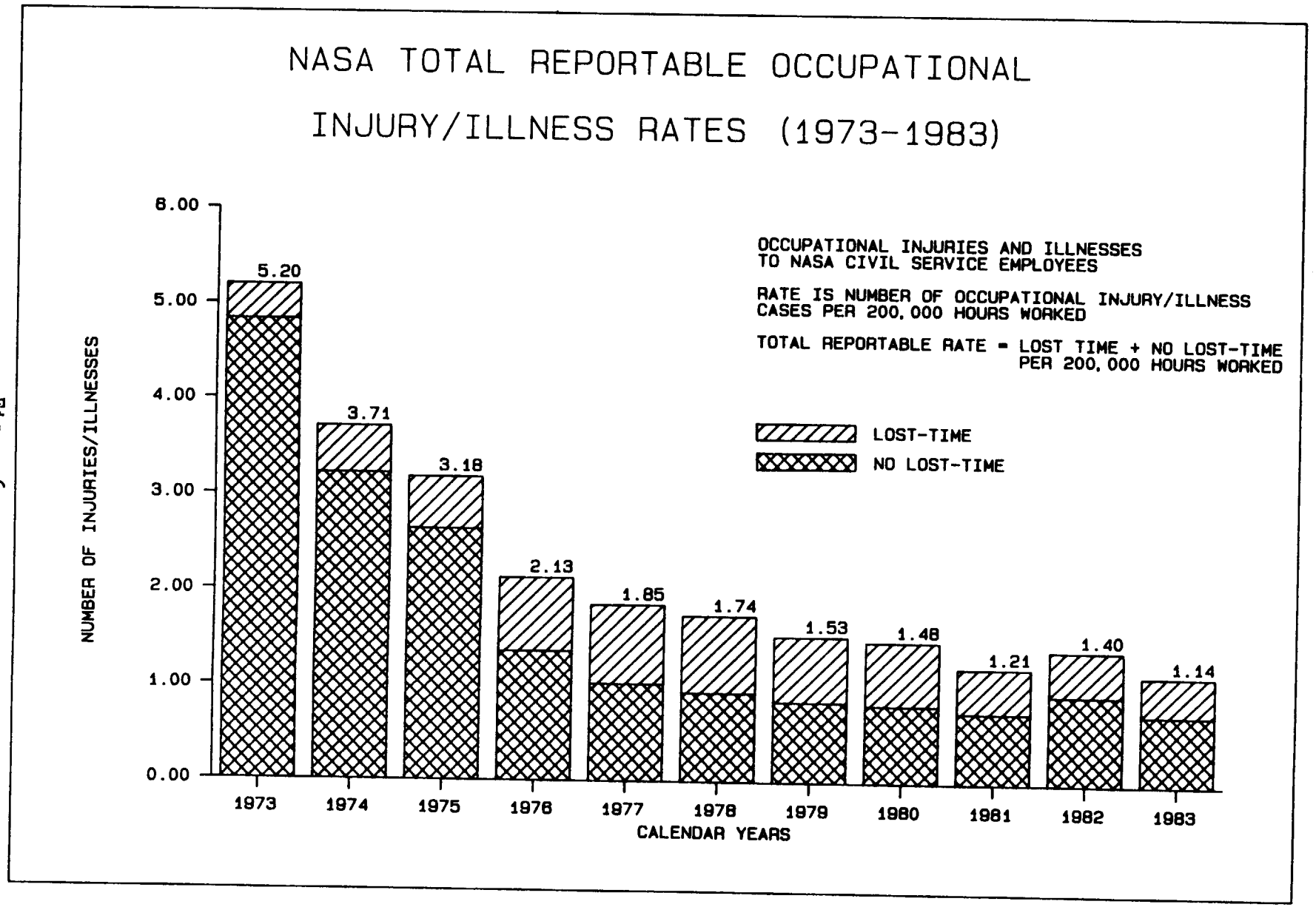

NASA TOTAL REPORTABLE OCCUPATIONAL
INJURY/ILLNESS RATES (1973-1983)
OCCUPATIONAL INJURIES AND ILLNESSES
TO NASA CIVIL SERVICE EMPLOYEES
RATE IS NUMBER OF OCCUPATIONAL INJURY/ILLNESS
CASES PER 200,000 HOURS WORKED
TOTAL REPORTABLE RATE = LOST TIME + NO LOST-TIME
PER 200,000 HOURS WORKED
LOST-TIME
NO LOST-TIME
NUMBER OF INJURIES/ILLNESSES
6.00
5.00
4.00
3.00
2.00
1.00
0.00
5.20
3.71
3.18
2.13
1.85
1.74
1.53
1.48
1.21
1.40
1.14
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
CALENDAR YEARS

Figure 6
16

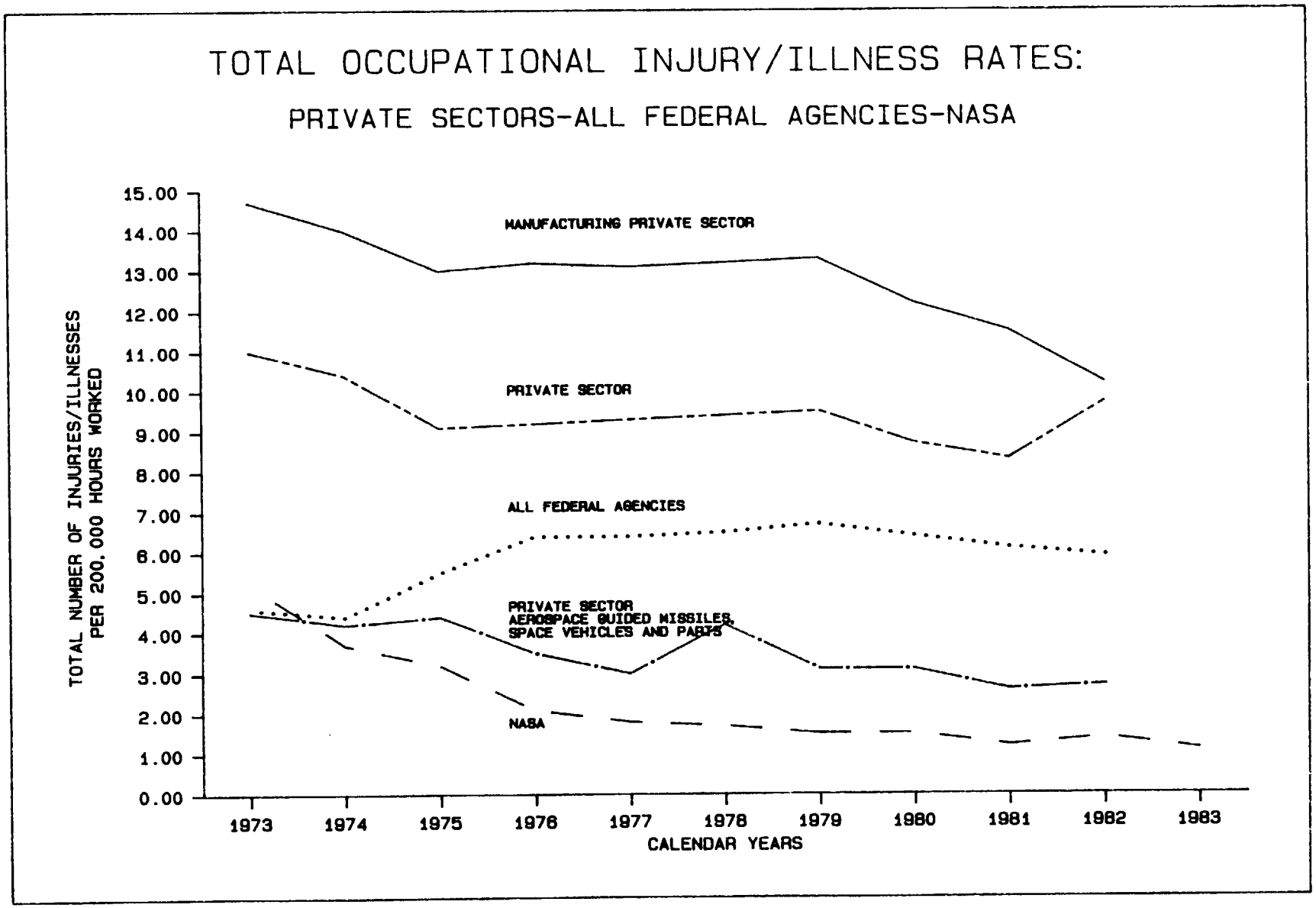

TOTAL OCCUPATIONAL INJURY/ILLNESS RATES:
PRIVATE SECTORS-ALL FEDERAL AGENCIES-NASA
TOTAL NUMBER OF INJURIES/ILLNESSES PER 200,000 HOURS WORKED
15.00
14.00
13.00
12.00
11.00
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
MANUFACTURING PRIVATE SECTOR
PRIVATE SECTOR
ALL FEDERAL AGENCIES
PRIVATE SECTOR AEROSPACE GUIDED MISSILES, SPACE VEHICLES AND PARTS
NASA
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
CALENDAR YEARS

Figure 7

TABLE 3. COMPARISON OF CY 1983 NASA INJURY/ILLNESS CASES WITH CONTINUATION-OF-PAY (C.O.P.) CASES

INSTALLATION	LOST-TIME INJURY/ILLNESS CASES[1]	C.O.P. CASES[2]
ARC/DFRF	7	8
GSFC/WFF	17	18
HQ	8	7
JSC	12	12
KSC	7	9
LaRC	7	31
LeRC	20	41
MSFC	7	11
NSTL	1	0
ALL NASA TOTAL	86	137

1. Number reported to OSHA
2. Number reported to OWCP

TABLE 4. COMPARISON OF INJURY/ILLNESS CASES AND RATES BETWEEN NASA FEDERAL EMPLOYEES AND MAJOR ONSITE SUPPORT CONTRACTORS

	FEDERAL EMPLOYEES			CONTRACTORS		
	HOURS WORKED (K)	CASES	FREQ. RATE	HOURS WORKED (K)	CASES	FREQ. RATE
ARC/DFRF	4,349	7	0.32	2,489	24	1.93
GSFC/WFF	7,316	17	0.46	6,468	24	0.74
HQ	2,992	8	0.53	630	0	0
JSC	6,171	12	0.39	17,658	85	0.96
KSC	4,883	7	0.29	22,241	92	0.83
LaRC	5,359	7	0.26	2,456	29	2.36
LeRC	4,755	20	0.84	1,125	10	1.78
MSFC	6,272	7	0.22	2,351	9	0.76
NSTL	264	1	0.76	1,739	12	1.38
ALL NASA TOTAL	42,360	86	0.41	57,157	285	1.00

COST TO NASA OF SAFETY RELATED LOSSES

Wages	:	$ 149,442
Chargeback billing:		$5,254,080
Aircraft[1]	:	$ 39,000
Vehicles[1]	:	$ 8,634
Fire[1]	:	$ 6,900
Other[1]	:	$ 500,062
Total		$5,958,118

DOLLAR COST OF SAFETY RELATED LOSSES

The per year total dollar cost to NASA for safety related losses is an inadequate indicator of the safety performance for that year. This is partially due to the chargeback billing for the cost of safety related losses in previous years carrying over to the current year.

Figure 8 illustrates this. It gives a history of the total annual safety-related costs to NASA from 1973 to 1983. Also shown is the portion of that total annual cost which was due to chargeback billing. As an example, the total cost in 1981 was $5.7 million compared to $6.0 million in 1983. However, the chargeback billing portion of that total increased from $4.2 million in 1981 to $5.3 million in 1983. Other losses in 1981 were $1.5 million, versus $0.6 million in 1983. Although the total amount paid out in the two years was roughly the same, losses incurred during 1981 were 2½ times more costly than those incurred during 1983.

CHARGEBACK BILLING

Chargeback billing is money paid out by NASA as workman's compensation for death or long-term disability cases. In any year, most of the money paid out as chargeback billing is as a result of injuries or illnesses occurring in previous years.

Figure 9 shows that of the nearly $6 million CY83 cost to NASA for accidents/incidents/injuries, about $5.2 million was chargeback billing. Approximately $5 million of this chargeback bill was incurred in previous years. This illustrates the fact that if NASA had had a perfect safety record in CY83 with zero property and wage losses, its CY83 accident/incident/injury costs would still be $5 million.

[1] Material losses not including mission or test failures ($554,596 total).

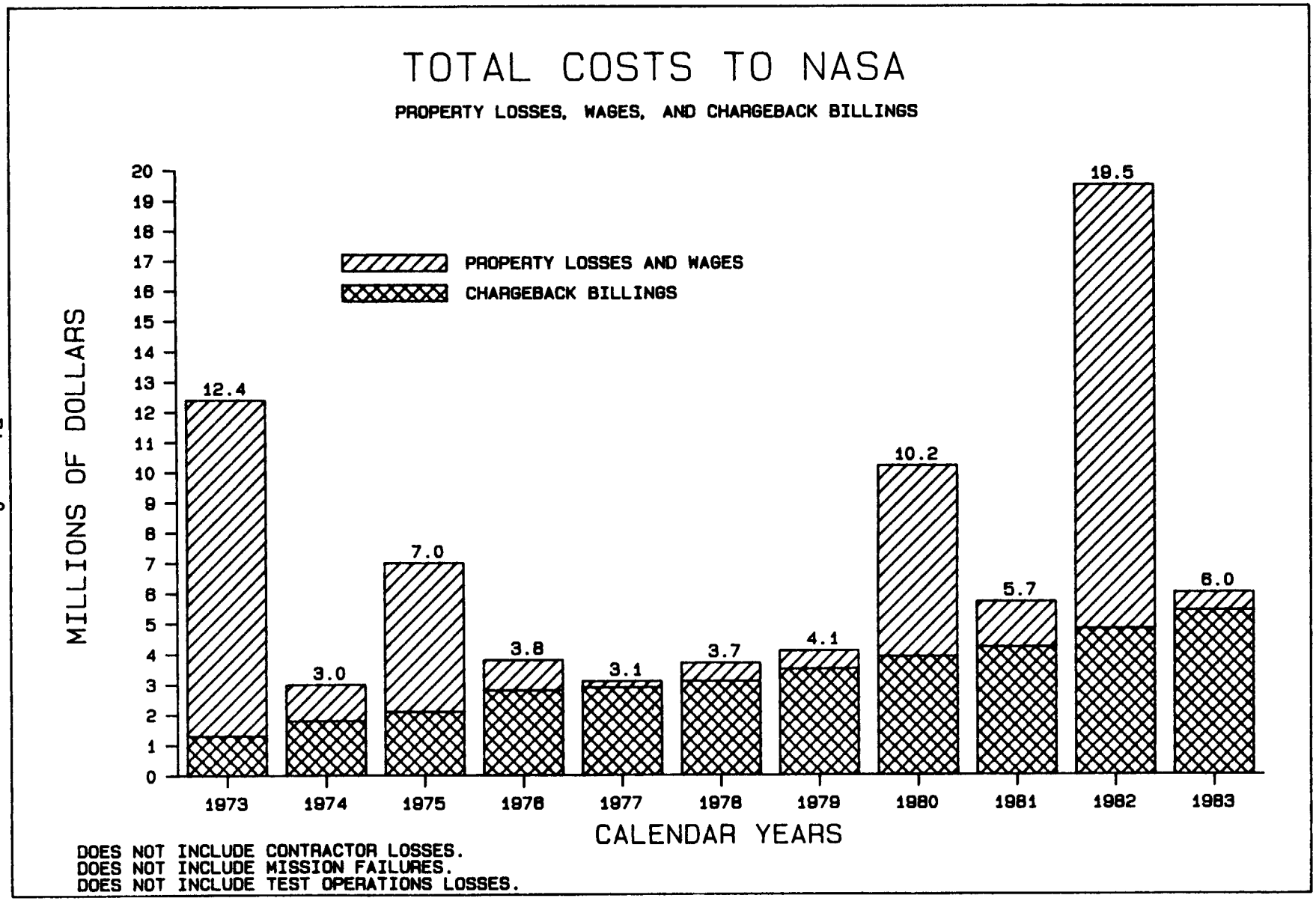
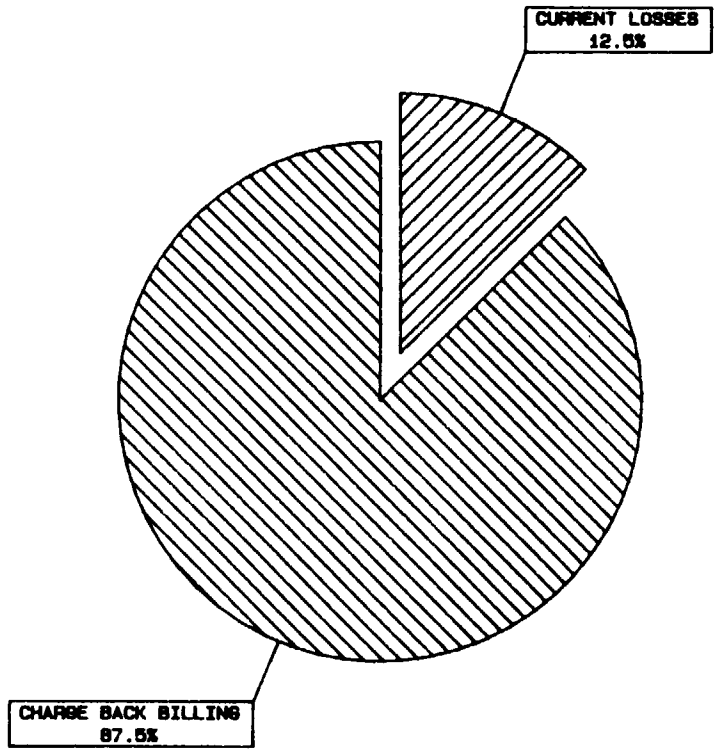

TOTAL COSTS TO NASA
PROPERTY LOSSES, WAGES, AND CHARGEBACK BILLINGS
MILLIONS OF DOLLARS
PROPERTY LOSSES AND WAGES
CHARGEBACK BILLINGS
12.4
3.0
7.0
3.8
3.1
3.7
4.1
10.2
5.7
19.5
6.0
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
CALENDAR YEARS
DOES NOT INCLUDE CONTRACTOR LOSSES.
DOES NOT INCLUDE MISSION FAILURES.
DOES NOT INCLUDE TEST OPERATIONS LOSSES.

Figure 8
21

COST OF CY 83 NASA ACCIDENTS/INCIDENTS/INJURIES

TOTAL LOSS = $ 5,957,568



*EXCLUDES CONTRACTOR DATA

Figure 9

Figure 10 compares the chargeback billings of the Federal Government to NASA for the years 1973 to 1983. The chart illustrates the rate at which costs of chargeback billings have been growing.

For the Federal Government in 1973 chargeback billing costs were approximately $170 million. By 1983, this cost had risen to $862 million, an increase of 410 percent. By comparison, chargeback billings for NASA over the same period increased from $1.2 million in 1973 to the present figure of $5.2 million in 1983, an increase of about 330 percent. The rate of growth in chargeback billing for NASA is 84 percent of that for the overall Federal Government.

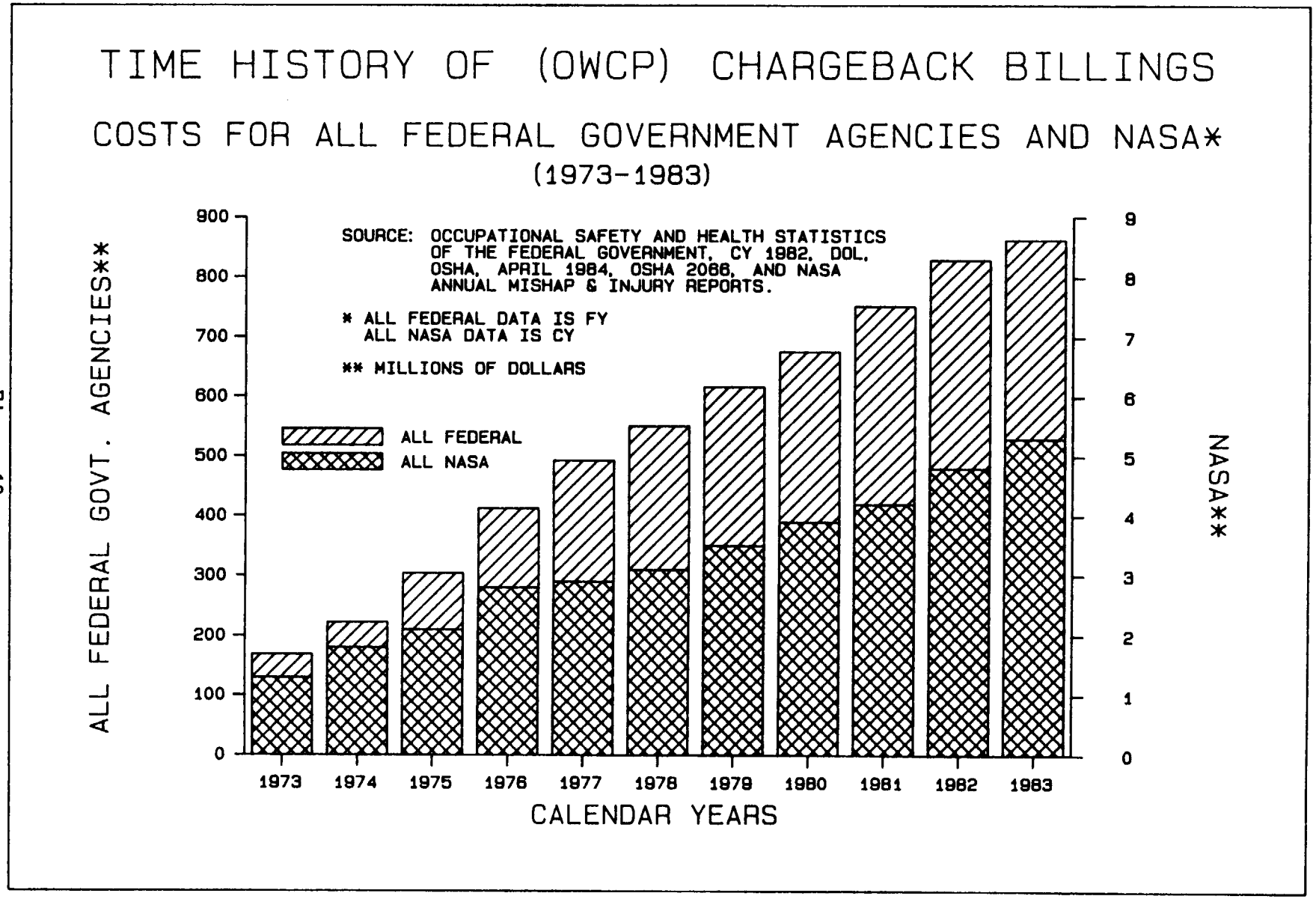

TIME HISTORY OF (OWCP) CHARGEBACK BILLINGS
COSTS FOR ALL FEDERAL GOVERNMENT AGENCIES AND NASA*
(1973-1983)
SOURCE: OCCUPATIONAL SAFETY AND HEALTH STATISTICS OF THE FEDERAL GOVERNMENT, CY 1982, DOL, OSHA, APRIL 1984, OSHA 2066, AND NASA ANNUAL MISHAP & INJURY REPORTS.
* ALL FEDERAL DATA IS FY
ALL NASA DATA IS CY
** MILLIONS OF DOLLARS
ALL FEDERAL
ALL NASA
ALL FEDERAL GOVT. AGENCIES**
NASA**
900
800
700
600
500
400
300
200
100
0
9
8
7
6
5
4
3
2
1
0
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
CALENDAR YEARS

Figure 10
24

MATERIAL LOSSES

Table 5 lists the CY 1983 NASA mishap data by center as reported on OSHA Form 102F and summarized for automobiles, aircraft, fire, and other mishaps. The material losses for all NASA are summarized below:

	$	No.
Aviation[1]	39,000	3
Automobiles[1]	8,634	19
Fire[1]	6,900	8
Other Property[1]	500,062	6
Total	554,596	32

Figure 11 gives a breakdown of some material losses over the last 11 years. A discussion of the three functional areas included - aviation, automobile, and fire - follows on the next pages. For 1983, the largest loss category was "Other Property," and the 6 mishaps comprising this loss are reported in the summaries.

[1]Material losses not including mission or test failures.

TABLE 5. NASA MISHAP DATA BY INSTALLATION -- ANNUAL 1983

	AUTO MISHAP FREQ. RATE		AIRCRAFT MISHAPS		FIRE LOSSES		OTHER MISHAPS		TOTAL MISHAPS COST	TOTAL MISHAPS RATE
	GOV	POV	NO.	RATE	NO.	($K)	NO.	($K)	($K)	($K)
ARC	1.01	0	3	69.46	6	5.86	3	376.95	422.63	97.18
GSFC	0	0	0	0	0	0	2	52.30	55.43	7.58
HQ	49.30	0	0	0	0	0	0	0	0.85	0.28
JSC	0	0.85	0	0	0	0	0	0	.55	0.09
KSC	0	0	0	0	0	0	0	0	0	0
LaRC	0	1.51	0	0	1	1.03	0	0	1.03	0.19
LeRC	3.08	0	0	0	0	0	0	0	3.20	0.67
MSFC	3.06	0	0	0	1	0.01	0	0	7.91	1.26
NSTL	0	0	0	0	0	0	1	63.00	63.00	238.85
TOTAL	1.81	0.27	3	14.48	8	6.90	6	492.25	554.59	13.09
LAST YEAR	3.80	0.81	3	13.13	9	75.40	36	13,133.94	14,120.16	336.96

1. Aircraft mishap frequency rate = no. of mishaps per 100,000 hours flown.

2. Motor vehicle mishap frequency rate = no. of mishaps per million miles driven.

3. Total cost of mishaps includes repairs/replacements of motor vehicles and damage, and tort claims (as on obsolete OSHA Form 102FF).

4. Mishap cost rate = total cost of mishaps per million hours worked.

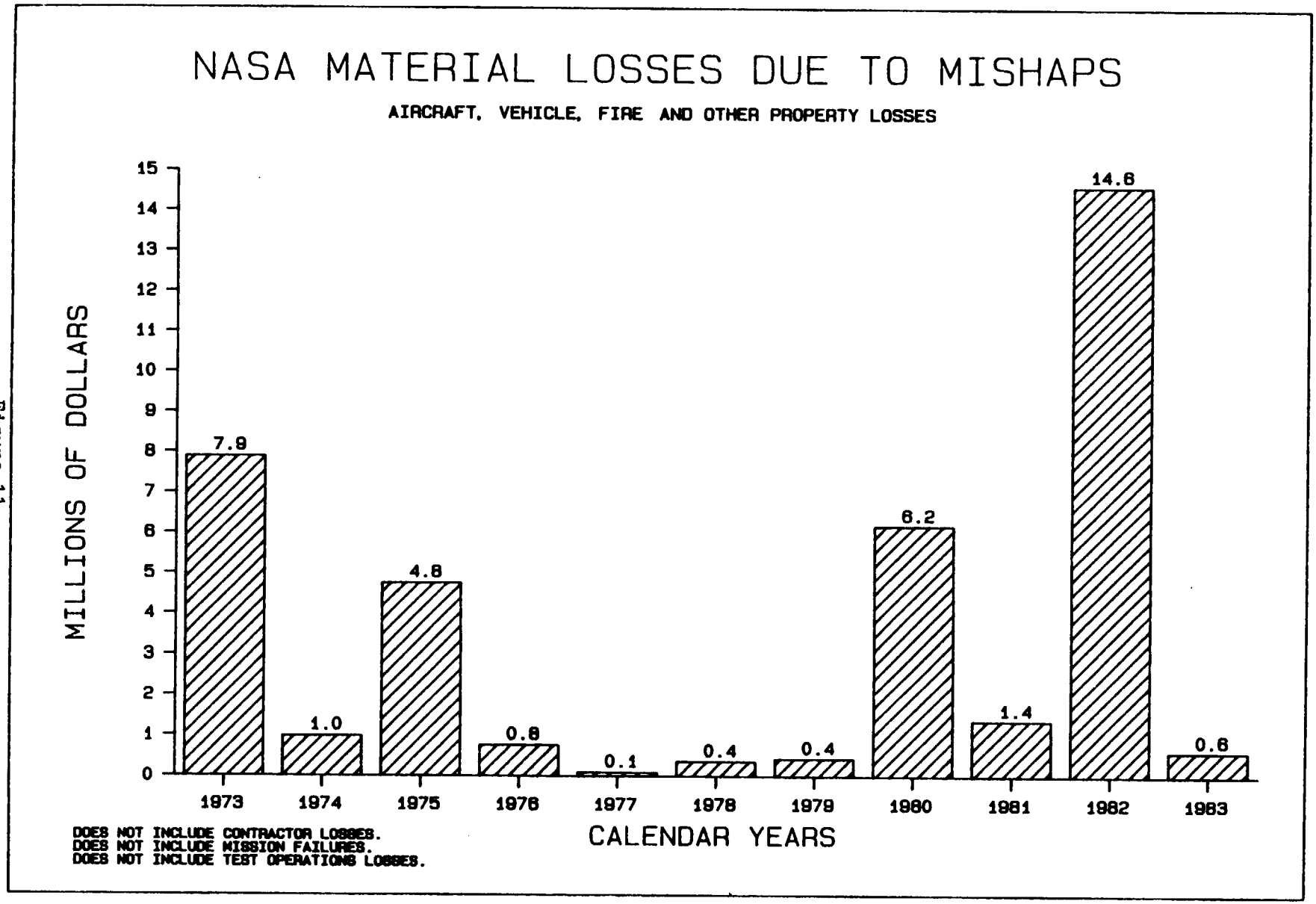

NASA MATERIAL LOSSES DUE TO MISHAPS
AIRCRAFT, VEHICLE, FIRE AND OTHER PROPERTY LOSSES
MILLIONS OF DOLLARS
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
7.9
1.0
4.8
0.8
0.1
0.4
0.4
6.2
1.4
14.6
0.6
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
CALENDAR YEARS
DOES NOT INCLUDE CONTRACTOR LOSSES.
DOES NOT INCLUDE MISSION FAILURES.
DOES NOT INCLUDE TEST OPERATIONS LOSSES.

Figure 11

NASA AVIATION SAFETY RECORD

Aircraft related fatalities in 1981 and 1982 prompted several new initiatives to evaluate and improve aviation safety. An independent review of the flight operations at three installations (Langley Research Center, Johnson Space Center, and Ames Research Center/Dryden Flight Research Facility) was completed. Safety research was undertaken in the area of aircraft misfueling and in the development of a digital flight data recorder. The first of planned annual Aviation Safety Officer meetings was held to promote a greater exchange of aviation safety information. In addition, a Headquarters reorganization established and filled a senior management level position for Director, Aircraft Management Office. To enhance communications and management oversight, the Director has revitalized the activities and flight operation reviews of the centers by the Intercenter Aircraft Operations Panel.

These initiatives, combined with outstanding aviation safety programs at the NASA field installations, resulted in a nearly accident free year in CY 1983. There was only one Type "C" aircraft accident reported in 1983, a bird strike as the ARC C-141 was departing Travis AFB, and the resulting damage necessitated engine replacement. Another bird strike incident occurred to a Lear Jet in Africa. Bird strikes are problems and can cause fatalities as one did in 1964 when an astronaut was killed. Research has been conducted on the subject of bird strikes and NASA aircraft operations should continue to be aware of and emphasize bird hazards.

The field organizations are commended for reporting the 1983 aircraft incidents. In many instances proper training, procedures, or circumstances prevented incidents from becoming serious accidents. For every major or fatal accident, several minor accidents and numerous incidents or near misses occur. The results and consequences of these mishaps vary widely, but usually only a miniscule difference exists between a near miss and an accident. Incidents with minor or no dollar loss often provide "lessons learned" for accident prevention. The main point is that we want to share "lessons learned" for accident prevention. Hopefully NASA will continue to avoid the "BIG ONES".

Figure 12 shows the cost of aircraft losses over the last 11 years.

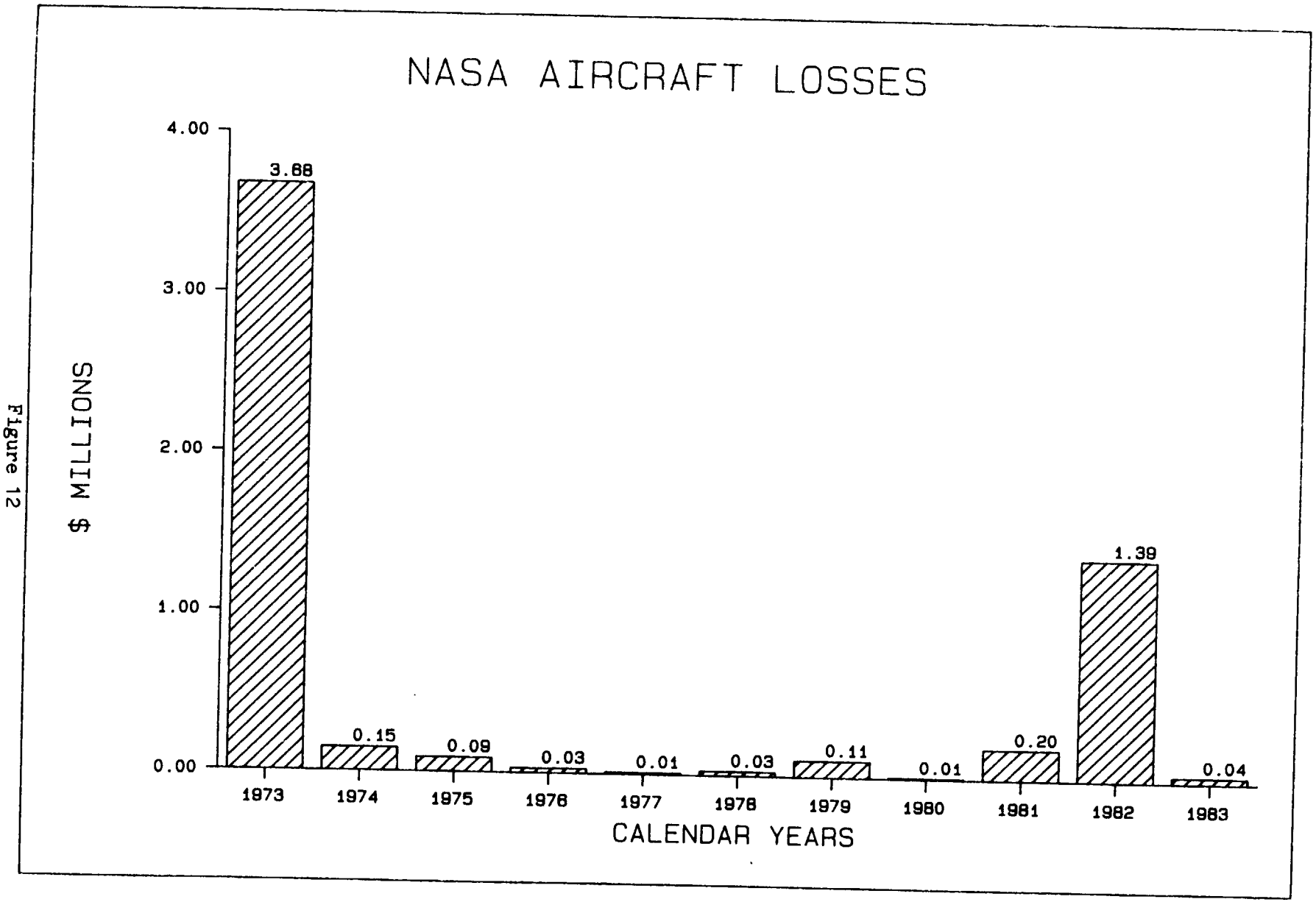

NASA AIRCRAFT LOSSES
4.00
3.00
2.00
1.00
0.00
$ MILLIONS
3.68
0.15
0.09
0.03
0.01
0.03
0.11
0.01
0.20
1.39
0.04
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
CALENDAR YEARS

Figure 12

NASA MOTOR VEHICLE SAFETY RECORD

The NASA 1983 Government automobile accident frequency rate of 1.81 accidents per million miles driven was less than half that of 3.80 for 1982. This rate was the lowest rate recorded in the past 11 years and significantly better than the goal of 5.0 we have used for several years. The cost of these accidents was $8K compared to the $15K in 1982. The number of private automobile accidents was 2, as compared to 5 for 1982, and the frequency rate of 0.27 was only 33 percent of the rate for 1982. Figures 13 and 14 show, respectively, the cost and frequency rate of automotive accidents over the last 11 years.

Table 6 breaks down motor vehicle accident data by installation. Four installations reported zero accidents while driving over 3.7 million miles in Government-owned vehicles, and seven installations reported zero accidents while driving over 5.5 million miles in privately owned vehicles on official business. This is 48 percent and 75 percent, respectively, of the total miles driven in each case.

Management is urged to continue the efforts that contributed to this record in 1983. Briefs of each reported incident, which show where attention can be directed, are contained on page 52. In one case, a driver was found to have a vision impairment after the accident, which may have been a contributing cause of the accident.

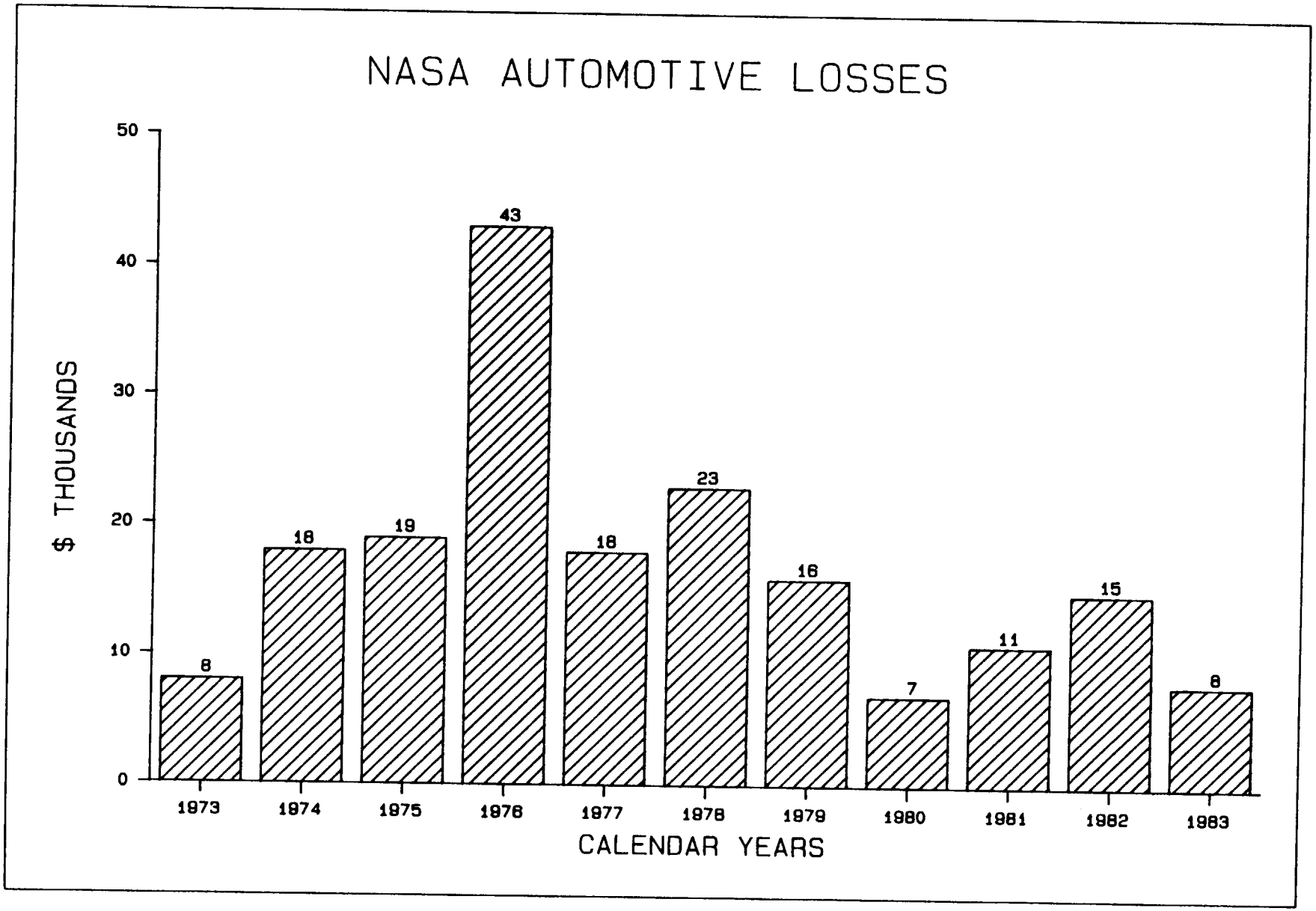

NASA AUTOMOTIVE LOSSES
$ THOUSANDS
50
40
30
20
10
0
8
18
19
43
18
23
16
7
11
15
8
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
CALENDAR YEARS

Figure 13

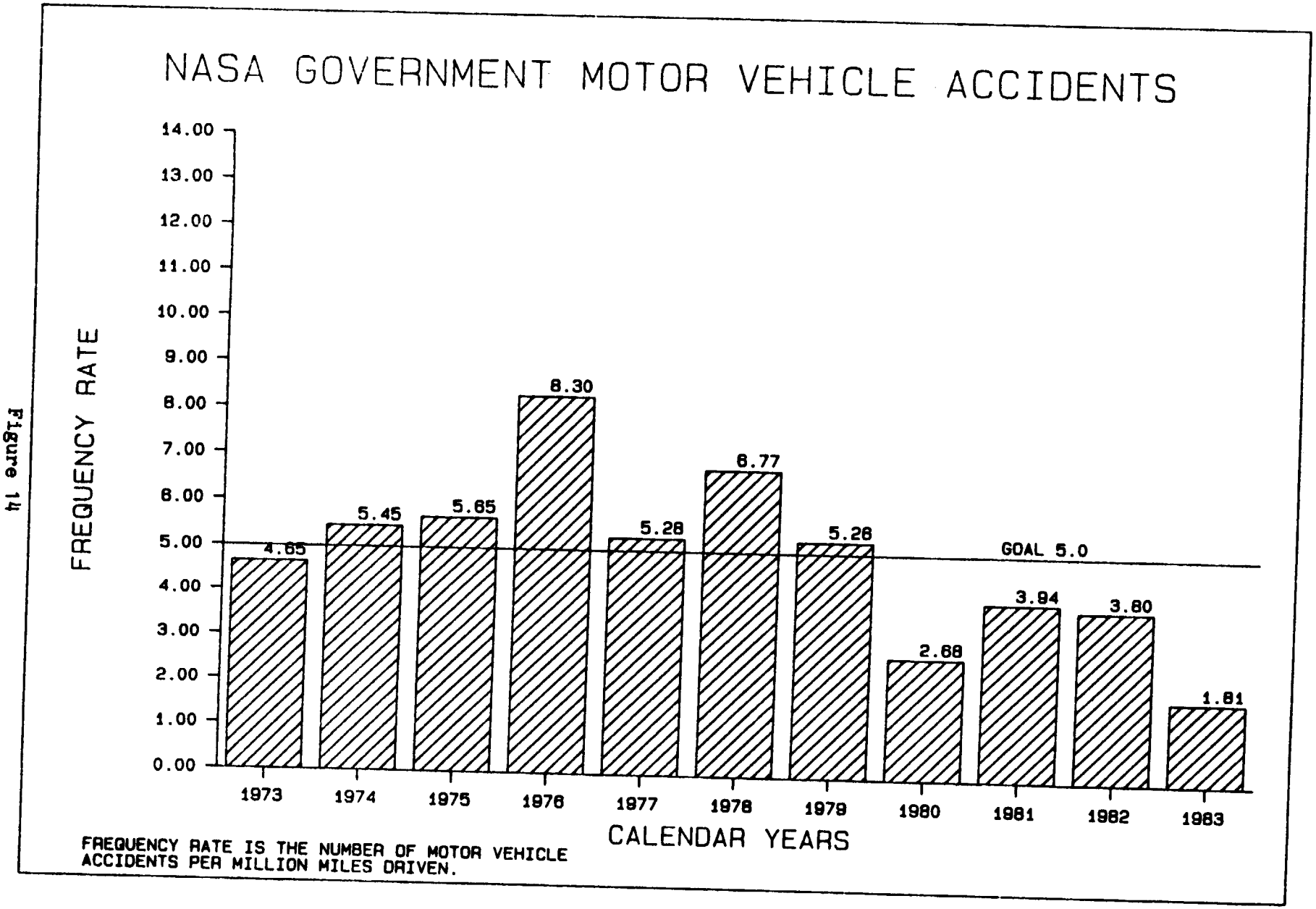

NASA GOVERNMENT MOTOR VEHICLE ACCIDENTS
FREQUENCY RATE
14.00
13.00
12.00
11.00
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
4.65
5.45
5.65
8.30
5.28
6.77
5.26
2.68
3.94
3.80
1.81
GOAL 5.0
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
CALENDAR YEARS
FREQUENCY RATE IS THE NUMBER OF MOTOR VEHICLE ACCIDENTS PER MILLION MILES DRIVEN.

Figure 14

TABLE 6. NASA 1983 MOTOR VEHICLE ACCIDENTS

Field Installations	No. of Accidents		Total Miles Driven (in thousands)		Total Cost ($)		Frequency Rate* of Accidents	
	Govt.	Private	Govt.	Private	Govt.	Private	Govt.	Private
ARC	1	0	994	1,121	672	0	1.01	0
GSFC	0	0	2,727	1,364	0	0	0	0
HQ	4	0	81	478	403	0	49.30	0
JSC	0	1	23	1,183	0	450	0	0.85
KSC	0	0	371	1,411	0	0	0	0
LaRC	0	1	588	663	0	0	0	1.51
LeRC	2	0	649	582	3,200	0	3.08	0
MSFC	7	0	2,291	576	3,809	0	3.06	0
NSTL	0	0	0	15	0	0	0	0
TOTALS	14	2	7,724	7,395	8,084	450	1.81	0.27
LAST YEAR	34	5	8,955	6,154	15,011	2,262	3.80	0.81

* Frequency rate is the number of accidents per million miles driven.

NASA FIRE EXPERIENCE

The number of fire mishaps in our facilities and equipment decreased from 9 in 1982 to 8 in 1983, as shown in Figure 15. The associated cost decreased from $75.4K in 1982 to $6.9K in 1983. This is shown in Figure 16. This number of reported fire mishaps is believed to be the lowest in NASA reported history and the dollar loss the lowest since 1977.

The continuing decline in numbers of fires and associated loss in buildings and facilities is a direct result of extensive fire prevention/protection activities and outstanding fire safety awareness generated in NASA after the Apollo spacecraft fire of 1967. There has been a continuing and substantial investment in fixed fire detection and suppression systems. Also, fire protection engineers have been added to most installations' safety staffs. These efforts have more than paid for themselves through reduced losses.

The fire risk analysis program initiated in 1982 was continued in 1983. The essence of this program is to have an independent insurance company perform an evaluation of each field center as if it were a private company wishing to purchase fire insurance. Using this technique we can compare the cost effectiveness of our self-insured NASA fire risk protection program with the most cost effective of the commercially insured industrial programs. The structures and facilities of the field centers are evaluated in terms of the Factory Mutual System's "Highly Protected Risk" to determine compliance with fire codes and standards, specifically those of the Factory Mutual System, the National Fire Protection Association (NFPA), the Federal Occupational Safety and Health Administration (OSHA), and NASA. The evaluated facilities were given ratings of Hazard Severity, Hazard Probability, and a Risk Assessment Code in accordance with the NASA definition of these terms. Overall recommendations were provided as appropriate. It is estimated that if NASA were to purchase Fire Risk Insurance based on a facility and structure evaluation of $12 billion, the cost would be approximately $3.8 million per year. Our fire loss experience during the last 11 years and in 1983 ($6,900 total), excluding mission and test failure fires, demonstrates the effectiveness of our program and the awareness of NASA employees in preventing fires.

The incorporation of fire protection engineering into design and all phases of facility construction must be continued in NASA as well as be incorporated programmatically. Although special precautions are taken during high-risk test operations, fires related to test failures still dominate our fire losses and are not included in the total loss figures of this report.

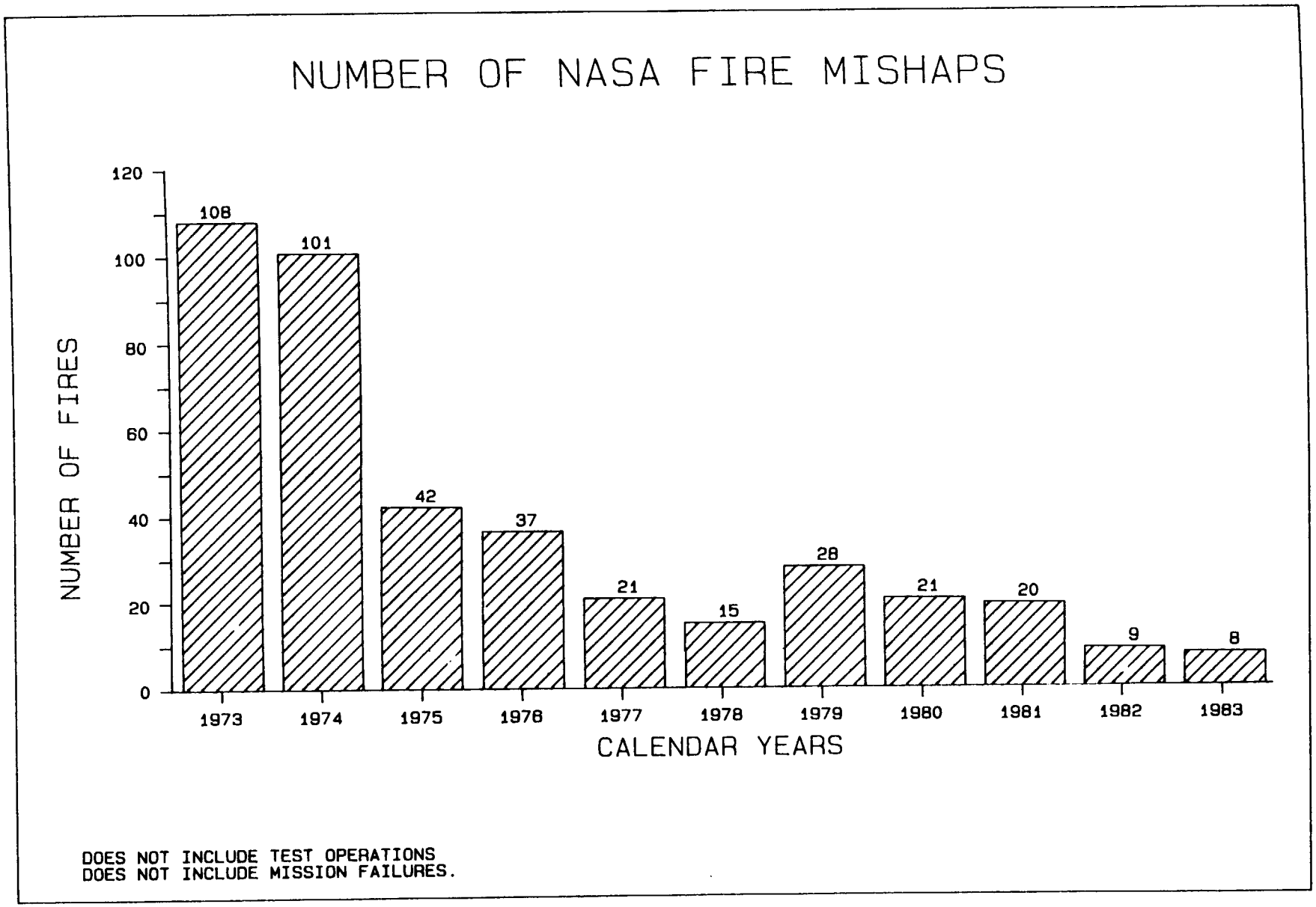

NUMBER OF NASA FIRE MISHAPS
NUMBER OF FIRES
120
100
80
60
40
20
0
108
101
42
37
21
15
28
21
20
9
8
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
CALENDAR YEARS
DOES NOT INCLUDE TEST OPERATIONS
DOES NOT INCLUDE MISSION FAILURES.

Figure 15

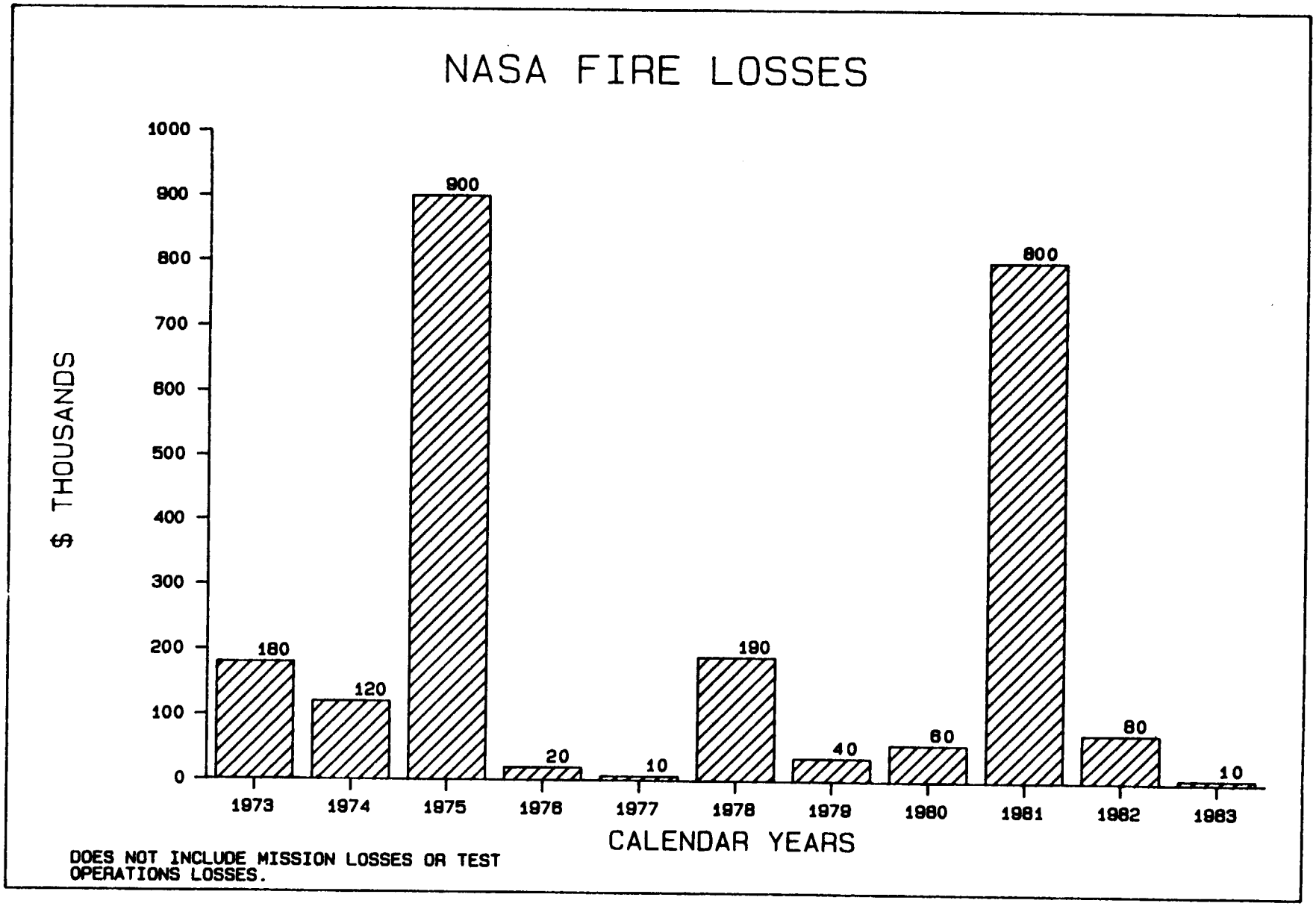

NASA FIRE LOSSES
$ THOUSANDS
1000
900
800
700
600
500
400
300
200
100
0
180
120
900
20
10
190
40
60
800
60
10
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
CALENDAR YEARS
DOES NOT INCLUDE MISSION LOSSES OR TEST OPERATIONS LOSSES.

Figure 16

NASA MISHAPS IN 1983

SIGNIFICANT MISHAPS

The significant mishaps shown in Tables 7 and 8 are those reported by the NASA field installations and contractors as having significance beyond the minor dollar losses or injury incident categories, and provide "lessons learned" for all NASA accident prevention programs.

Although Test Operations accidents and mission failures are not discussed in most sections of this report, they are included in Table 8 for 1982 and 1983, and in the next several pages of descriptive material. These types of mishaps are associated with program activities and are reviewed in detail by program offices. This does not reduce any safety responsibilities for NASA operations. However, it recognizes that these mishaps occur at facilities where the nature of operations involve predictably high risks and hazards. An example is the 1983 Class A mishap involving the loss of a Drone for Aerodynamic and Structural Testing (DAST), which is a Remotely Piloted Research Vehicle (RPRV). This is representative of a high risk, high hazard research program where more sophisticated test vehicles might have reduced risks but at a significantly higher cost.

Figure 17 presents an 11-year overview of NASA Type A, B, and the newly defined Type C mishaps. These categories are defined in terms of dollar amount of loss, and the limits for each category have been escalated over the years, largely due to inflation. Therefore, unfortunately, it is not possible to compare the individual categories directly from year to year. However, one can look at the total number of mishaps, which was 11 in 1983 compared with 20 in 1982 and 30 in 1981. This dramatic decrease is accompanied by the decrease in costs highlighted earlier. The year has also seen a reduction in the costs of mission and test operations failures, and the number of contractor mishaps. It is hoped that this trend can be continued. Selected summaries are presented which may provide "lessons learned" and give clues for additional improvements in the future.

DEFINITIONS

1. NASA Mishap. Any unplanned occurrence, event, or anomaly that may be classed as a Type A, B, or C mishap, incident, or mission or test failure involving NASA personnel, equipment, or facilities.

2. NASA Contractor Mishap. Any unplanned occurrence, event, or anomaly that may be classed as a Type A, B, or C mishap, incident, or mission or test failure that involves NASA contractor personnel or equipment in support of operations at NASA. These are normally investigated by the contractor and reviewed by NASA or, depending upon circumstances, investigated separately by NASA when directed by a NASA official with board appointment authority.

3. Type A Mishap. A mishap causing death, damage to equipment or property equal to or exceeding $500,000, or destruction of an aircraft or space hardware. For NASA mishaps, these are investigated by a board appointed by the appropriate Program or Institutional Associate Administrator.

4. Type B Mishap. A mishap resulting in permanent disability to one or more persons, hospitalization of five or more persons, or damage to equipment or property costing between $250,000 and $500,000. For NASA mishaps, these are investigated by a board appointed by the Field Installation Director.

5. Type C Mishap. A mishap resulting in damage to equipment or property costing between $25,000 and $250,000, or causing occupational injury or illness which results in a lost work day case or a restricted duty case. These are analyzed locally by committees or individuals unless circumstances dictate a more formal investigation.

6. Mission Failure. Any event of such a serious nature that it prevents accomplishment of a majority of the primary mission objectives (investigation board probably required).

7. Test Failure. An unexpected event which jeopardizes a test, prevents accomplishment of major test objectives, causes premature test termination, or destroys test hardware, test stands, or monitoring equipment. Test failures generally result in monetary losses of $25,000 or more, or have significant program impact or public or political visibility. When low cost models and other test items, which are specifically designed to meet special test conditions where damage or loss is likely to occur, are damaged or destroyed, the circumstances will largely determine if it is a test failure or an expected or likely result of the test. (When a part or assembly fails without significant monetary loss or program delay, this is not considered a test failure by this definition.) Test failures will be investigated or analyzed as determined by program personnel.

8. Incident. An unplanned occurrence consisting of less than Type C severity of injury to personnel, or property damage less than Type C but greater than $500. A near miss that could generate widespread interest due to its circumstances or potential may be included in this category.

9. Near Miss. An unplanned occurrence in which there is no injury, no property damage, and no interruption to productive work, but which possesses potential for any of the foregoing.

10. Costs. Direct costs of repair, retest, delays, replacement, or recovery of NASA materials, including hours, material, and contract costs, but excluding indirect costs of cleanup, investigation, injury, and normal operational delay.

TABLE 7. FATAL ACCIDENTS AND FATALITIES

CALENDAR YEAR	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
NASA EMPLOYEES	7	0	0	0	2	0	1	0	4	1	0
CONTRACTOR EMPLOYEES	4	1	1	1	3	1	0	0	5	1	0
PUBLIC	1	2	2	0	1	0	0	0	0	0	0
MILITARY	5	0	0	0	0	0	0	0	0	0	0
TOTAL NUMBER OF FATALITIES	17	3	3	1	6	1	1	0	9	2	0

TABLE 8. TYPE A/B/C MISHAPS BY FIELD INSTALLATION

CALENDAR YEAR	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
ARC/DFRF	0/1	0/2	0/1	1/1	0/0	1/3	0/6	0/0	2/3	2/3	1/0/2
GSFC/WFF	0/1	1/2	0/2	0/2	1/4	0/0	0/1	1/1	0/3	1/0	1/0/1
HQ	-	-	2/1	0/0	0/1	0/0	0/0	0/0	0/0	0/0	0/0/0
JSC	1/0	0/5	0/1	0/0	2/1	0/1	0/2	1/0	2/0	2/1	0/0/0
KSC	0/1	2/1	4/1	0/0	2/1	0/0	0/0	0/1	5/3	1/2	0/0/1
LaRC	0/1	0/1	0/2	1/1	0/0	0/1	0/0	0/0	3/4	1/0	0/0/0
LeRC	0/1	0/0	0/1	0/1	0/0	0/0	1/1	0/0	0/2	0/0	0/0/2
MSFC	1/0	1/0	1/1	0/0	1/0	0/0	0/0	2/1	1/0	4/2	0/1/2
NSTL	-	0/0	0/1	0/1	1/0	0/0	0/0	0/0	1/1	1/0	0/0/0

Notes:

1. Type "C" was first defined this year and replaces the previously defined Type "B" incidents.
2. Type "B" and "C" individual injuries are not shown in this table; numbers for these are presented in Table 1.
3. Mission and Test failures are included in these numbers.

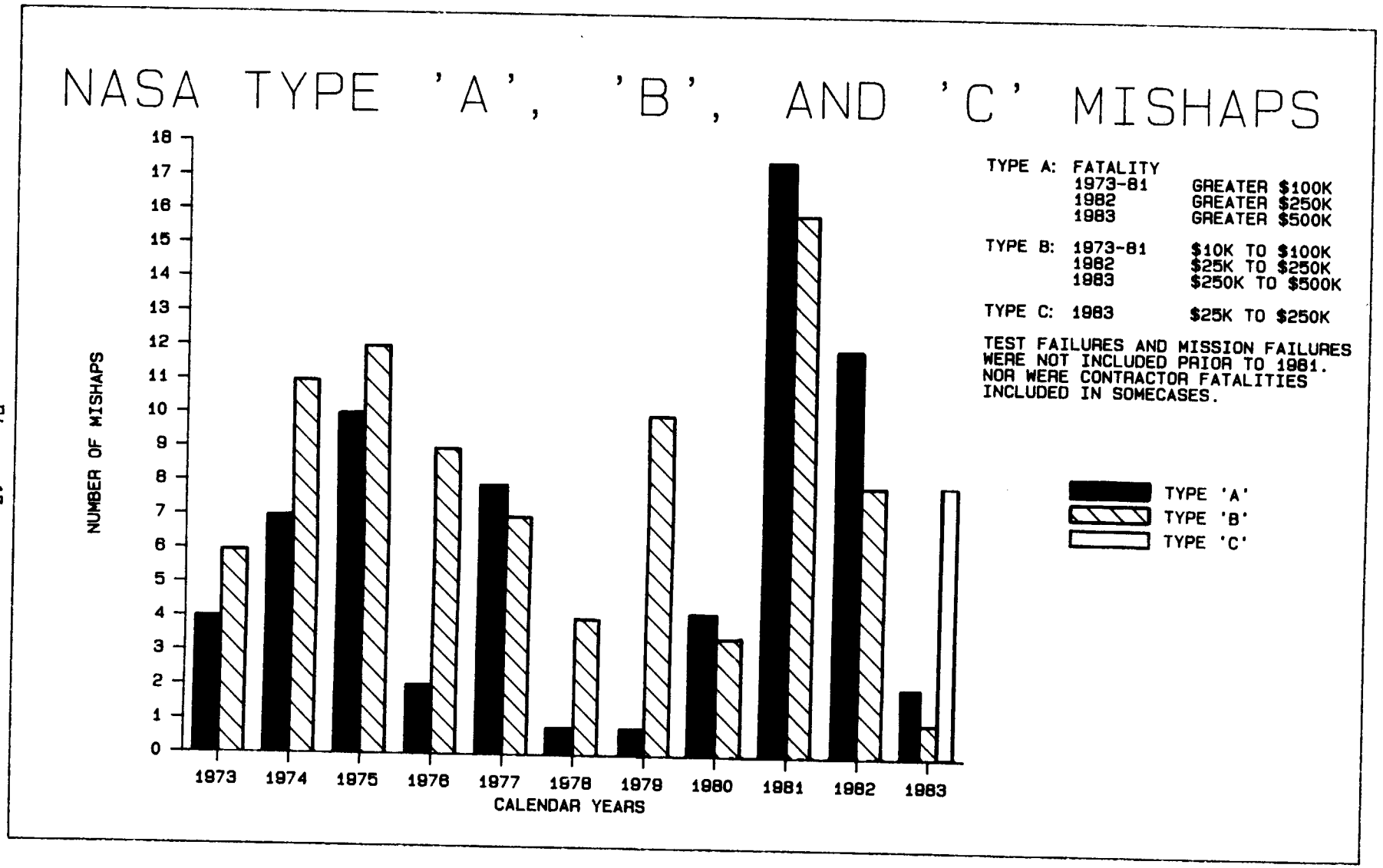

NASA TYPE 'A', 'B', AND 'C' MISHAPS
NUMBER OF MISHAPS
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
CALENDAR YEARS
TYPE A: FATALITY
1973-81 GREATER $100K
1982 GREATER $250K
1983 GREATER $500K
TYPE B: 1973-81 $10K TO $100K
1982 $25K TO $250K
1983 $250K TO $500K
TYPE C: 1983 $25K TO $250K
TEST FAILURES AND MISSION FAILURES WERE NOT INCLUDED PRIOR TO 1981. NOR WERE CONTRACTOR FATALITIES INCLUDED IN SOMECASES.
TYPE 'A'
TYPE 'B'
TYPE 'C'

Figure 17

TYPE A MISHAPS - 1983

LOCATION	DATE	DESCRIPTION	CAUSE	COST	"LESSONS LEARNED"/ RECOMMENDED CORRECTIVE ACTIONS
DFRF	06/01/83	Flight test failure, Flight 18 of DAST (Drones for Aerodynamic and Structural Testing). Modified Firebee II RPRV (Remotely Piloted Research Vehicle) carrying LaRC aeroelastic research wing crashed shortly after launch from Lockheed Air Service operated, Navy owned, DC-130 Aircraft. The parachute recovery system initiated, uncommanded, immediately after launch, and precluded normal deployment and normal Mid-Air-Retrieval System (MARS) recovery. The RPRV was destroyed on ground impact, with no injuries and no significant property damage, except the DAST.	Three distinct, separate and unrelated anomalies occurred in rapid succession. The probable cause of the 1st anomaly, the uncommanded recovery signal, was electrical spikes introduced into the logic card during umbilical connector separation from the DC-130 carrier aircraft. A 3-second delay designed to prevent the command control of the vehicle for 3 seconds after launch had been intentionally removed from the logic card for this flight. The 2nd anomaly, the premature deployment of the drag chute, was probably caused by a failure in the drag chute 10 second timer circuit. Some timer circuit failures have occurred in operational military target drones due to corrosion of the tantalum capacitors, resulting in a timeout circuit.	$1.8M*	• Reinstall time delay circuits on logic cards. • Conduct thorough analysis of the effects of electrical spikes. • Review launch configuration with control surfaces active or fixed. • Ensure DAST battery applied to battery buses before launch. • Analyze and, if warranted, disconnect aircraft power ground wires between the DAST and aircraft before launch. • Replace CLR65 or CL67 tantalum capacitors with CLR79 tantalum capacitors. • Analyze recovery system circuitry. Determine practical/feasible modifications.

*By agreement between HQS and DFRF, DAST vehicles were considered expendable. RPRVs have merit as expendable vehicles for high risk flight research and experiment carriers. Complexity, redundancy, reliability, project team size, etc., rise dramatically, together with costs, when manned larger vehicles are utilized. DAST utilizes proven and available, lower cost Firebee II vehicles and some losses are anticipated. The investigation board in this DAST flight failure conducted an extensive investigation. Managers involved in other high risk experiments with expendable or low cost launch or test vehicles (e.g., expensive payloads on obsolete, expendable launch vehicles, sounding rockets, balloons, etc.) can benefit from valuable lessons learned. NASA managers need to address issues involved with planning and trade-offs in selecting an expendable carrier vehicle for high risk experiments.

TYPE A MISHAPS - 1983 (cont.)

LOCATION	DATE	DESCRIPTION	CAUSE	COST	"LESSONS LEARNED"/ RECOMMENDED CORRECTIVE ACTIONS
			The 3rd anomaly, unrelated to the other two anomalies and resulting in the vehicle loss, was the inadvertent firing of the main chute riser release pyrotechnics. This anomaly probably occurred simultaneously with the firing of the main chute canister pyrotechnic allowing normal main chute deployment. The main chute (still in its canister) was therefore disconnected from the vehicle resulting in its loss. The probable cause of this inadvertent firing was the application of an electrical ground on relay K216, whose energization initiates the parachute deployment sequence. The most probable source of the ground was in the wiring from the K216 relay at any number of points in the power distribution box or vehicle wire bundles.		• Conduct DAST launches only from DFRF B-52. • Address concerns identified by investigation board if alternate launch vehicle used in future. • Modify proven Firebee and DAST recovery system to reduce complexity and provide sufficient redundancy to assure that no single failure in the recovery system will preclude normal parachute deployment. • Conduct thorough study and test program to uncover sneak circuits and ground loops prior to flight. • Conduct a complete system design review before next flight. • Assure that an experienced and adequately staffed project team is organized and kept intact; establish and document a DAST Project formal priority so that commensurate high level commitments by functional organizations are made in writing and kept; and devise and

TYPE A MISHAPS - 1983 (cont.)

LOCATION	DATE	DESCRIPTION	CAUSE	COST	"LESSONS LEARNED"/ RECOMMENDED CORRECTIVE ACTIONS
					implement a method for retrieving current and historical cost-time information for use in planning, scheduling, and tracking by all levels of management. • Use controlled process for development, review and approval of procedures checklist. • Make and maintain adequate electrical drawings.
Palestine TX	06/20/83	Gondola free-fell at termination of balloon flight and was destroyed by ground impact.	Flange sheared at parachute opening.	$1.7M	• New structural design criteria established on interim basis. • New spec and criteria under development. • Stringently enforce inspection procedures.

TYPE B MISHAPS - 1983

LOCATION	DATE	DESCRIPTION	CAUSE	COST	"LESSONS LEARNED"/ RECOMMENDED CORRECTIVE ACTIONS
MSFC/ Contractor's Plant	10/10/83	Lightweight Solid Rocket Motor (SRM) casting segment burst during pressure test. Test oil ignited and caused damage to Contractor's facility.	Suspect SRM case cracked during splashdown. This crack propagated and caused the case to fail during pressure test releasing a considerable amount of the 30 thousand gallons of test oil. The oil ignited (probably from a broken electric line or light) and the fire created a chimney torch effect on the exposed wood ceiling of the facility.	$253K (Contractor's)**	• Aerosol action of pressurized hydro test oil leak can optimize the conditions for ignition of the oil. • Water lines for fire suppression systems in test area must be shielded to protect them from maximum test failure mode. • Electrical lines and lights in test area should be deactivated or protected to preclude them from becoming an ignition source during test. • Test failure hazards analysis should evaluate hazards not only to personnel but also to facilities. • Test facility fluid containment evaluation should consider fire water volume and handling. • Cable trenches and raceways should be considered as pathways for fluids and fire under walls to other areas.

**SRM case value not included since some damage and loss had been incurred on ocean impact and recovery.

TYPE B MISHAPS - 1983 (cont.)

LOCATION	DATE	DESCRIPTION	CAUSE	COST	"LESSONS LEARNED"/ RECOMMENDED CORRECTIVE ACTIONS
Various*	CY 1983	Two Type B and four Type C sounding rocket failures.	Premature extension of experiment drawers. Nose cone deployment failure. Separation malfunction. Fuse failure. Improper functioning of baroswitch. Telemetry loss-improper mating of plug.	$1,270K	• Fire Department access to areas for purpose of fire suppression needs to be preplanned. • Test failure evaluations should include scenarios of failure at various points and in various directions. • Thoroughly address mechanisms furnished by experimenters. • Pressurization ejection system must be fully pre-flight tested. • Experiment/payload electrical interface must be thoroughly understood by both parties. • Location of baroswitch must provide for sufficient venting. • Proper mating of flight connectors shall be verified by at least two people.

*Not included in statistics; addressed here for lessons learned purposes.

TYPE C MISHAPS - 1983

LOCATION	DATE	DESCRIPTION	CAUSE	COST	"LESSONS LEARNED"/ RECOMMENDED CORRECTIVE ACTIONS
ARC	01/22/83	Flooding of electrical service building (N249A) at Static Test Facility under construction. Over weekend county power failure and/or sump pump failure resulted in flooding of electrical equipment under four feet of water. Water gained access through four open electrical conduits below water level in excavation.	Power failure. Sump pump failure. Open electrical conduits into building under construction.	$230K	o More frequent inspections. o Contracting procedures in writing. o Add electrical feeder from ARC. o Add standby fueled electrical generator for pump and other emergency equipment.
LeRC	02/01/83	ERB-W-7 Test Cell Failure; Research hardware failure of third stage rotor blades for a 5-stage multistage compressor 74A. No facility damage occurred.	High cycle fatigue of blade material.	$200K	o The need for shop peening of blades should be reviewed. o Level of margin between blade resonant frequency and potential resonant producing sources should be re-evaluated. o Review of methods used to generate blade resonance interference diagrams should be made to more accurately represent operating state of blades.
GSFC	02/11/83	Inflatable building collapsed due to heavy snow accumulation.	Severe storm.	$ 50K	o Pressure alarms installed to alert console of pressure fluctuation.
KSC	02/16/83	During sea operations a diver-operated plug (DOP) on the Solid Rocket Booster (SRB) sank in 460 fathoms. DOP not retrieved.	DOP suspended by floats was oscillating at different rate than OTF. OTF aft skirt struck the snap hook, or DOP, shearing it off.	$ 36K	o Redesign of the DOP provides ballasting capabilities and permits diver to take DOP down. o Position floats downwind; divers descend with DOP attached by safety line to floats. o When under/to side of aft skirt a snap-line from DOP to aft skirt hold down holes required.

TYPE C MISHAPS - 1983 (cont.)

LOCATION	DATE	DESCRIPTION	CAUSE	COST	"LESSONS LEARNED"/ RECOMMENDED CORRECTIVE ACTIONS
LeRC	03/04/83	High Pressure Facility-Test Failure; Research hardware failure of five test blades and twelve other blades of the High Pressure Turbine.	Stress rupture of turbine blades due to over-temperature at normal stress levels.	$225K	o Add additional instrumentation to display gas stream temperature and vane metal temperature. o Reduce or eliminate the number of parameters which initiate emergency shutdown. o Revise fuel-GN_2 system to increase safety/reliability.
MSFC/ Contractor	10/08/83	Combustion chamber for Space Shuttle Main Engine (SSME) was undergoing heating in preparation for the hot wax injection into the cooling coils. The chamber was resting on a wooden pallet in an oven and the pallet ignited in the 300°F heat.	Heat caused ignition of the pallet.	$50K	o Prohibit use of flammable materials in heat treat oven.
MSFC/MAF	10/14/83	Fire in a room used for spray foam insulation resulted in damage to the room.	Exothermic reaction ignited plywood.	$46K	o Procedures changed to preclude excessive foam thickness.
ARC	11/14/83	NASA 714 aircraft, a Lockheed C141, Starlifter, had a bird strike departing Travis Air Force Base, CA. An engine was damaged and required replacement.	Bird strike.	$45K	o Continue emphasis of bird hazard programs.
Various*	CY 1983	Eight Type C balloon flight failures.	Balloons generally failed during ascent but with successful payload recovery.	$2,679K	o New design techniques instituted for super heavy balloons. o New film acceptance procedure and criteria established. o Tighter maintenance instituted on ballast/valve system. o Retrofit of accessories properly performed.

*Not included in statistics: addressed here for lessons learned purposes.

DATE	DESCRIPTION	CAUSE	COST	"LESSONS LEARNED"/ RECOMMENDED CORRECTIVE ACTIONS
04/17/83	A small amount of Monomethyl Hydrazine (MMH) fuel was spilled during the removal of ferry plugs from the Forward Reaction Control System (FRCS) thrusters on the Space Shuttle Orbiter Vehicle, OV-099 (CHALLENGER), in the Orbiter Processing Facility (OPF) at KSC. As a result, 10 persons were evaluated by medical services for exposure to the fuel. Eight were released immediately by medical and two were hospitalized for further observation and released a few days later.	The probable cause of the leakage was sensitivity of the thruster valve seals to temperatures below 60°F, when non-uniform thermal contraction characteristics and variations in the teflon seal surfaces accentuate the potential for leakage. The Ferry Plug Removal Procedure was downgraded from SCAPE requirement to faceshield, coveralls, and propellant handlers gloves. The Hypergol Exhaust System did not function properly and some confusion concerning the exhaust system activation indicating lights exists. Personnel not directly essential to Orbiter processing were present in OPF. The emergency response actions were not coordinated effectively. The new Job Card work document did not provide adequate control for a hazardous operation. The OPF high bays cannot be adequately evacuated by word of mouth or by the local public address paging system.	N/A	• Anytime a hazardous system is exposed to a condition outside of its design criteria (i.e., low temperature) an immediate review will be conducted to determine how downstream operations may be affected. • Anytime a modification or major work is performed on a critical system, the system will be tested end to end to verify proper operation and function. Emergency warning systems will be pre-mission tested. • Authorization/responsibility assignments are established and are clear to all concerned. • Practices of simulated emergency situations are conducted to coordinate operational and emergency response team actions. • Hazardous procedures are thoroughly reviewed and updated. New work control documents will not be introduced into the work areas until proper safety approval has been obtained.

NASA INCIDENTS - 1983 (cont.)

DATE	DESCRIPTION	CAUSE	COST	"LESSONS LEARNED"/ RECOMMENDED CORRECTIVE ACTIONS
06/28/83	G-159 Aircraft (Gulfstream G-1) NASA 3, lost "Quick Release" pin. Vibration and "Shimmey" noticed upon landing at MSFC; damage sustained in nosewheel steering mechanism. Pin was on preflight checklist and thought to be in place when aircraft left Houston for MSFC.	Unknown. Possibly pin was not fully in place and fell out or was broken.	$10K	o Increase awareness of pin on preflight checklist and assure both condition and locked fully in place.
06/29/83	Rotor Systems Research Aircraft (RSRA), NASA 740, was making landing approach to NASA MOFFETT in airplane mode at 160 knots airspeed when left-main landing gear door (Honeycombed Fiberglass Construction) came apart. Precautionary landing executed in which right tire blew.	Door, although previously tested at 220 knots, was underdesigned.	N/A	o Door was strengthened in redesign by Sikorsky. o ARC reviewed and flight tested. o RSRA now being flown at DFRF in safer area for public.
07/31/83	G-1159 Aircraft, NASA 946, STA. Attachment bracket for the hydraulic actuator that controls the nose gear cracked as the nose landing gear was being extended. Although pilots did not get gear light indication, the gear was verified down and locked. Foam was put on runway and precautionary landing executed without incident.	Fatigue failure of nose landing gear retract cylinder attachment lugs.	Unavailable	o When aircraft is used as shuttle trainer, nose gear is extended near maximum designed airspeed limits. Caution is now exercised to not exceed limit. o Problem is still under investigation by JSC and Grumman to improve design.
08/23/83	ER-2 Aircraft, NASA T06, lost fiberglass afterbody of superpod, about 3"x1½" and 5 lbs., upon descent from flight level 500, 50-100 miles SE of San Jose. Pilot unaware of loss until after postflight.	Probable cause was structure over-pressurized due to ATC increasing rate of descent to 5,000 fpm at flight level 240. Poor vacuum relief valve operation.	$20K	o Vacuum relief valve redesigned. o Strengthen design. o Don't exceed design limits.

NASA INCIDENTS - 1983 (cont.)

DATE	DESCRIPTION	CAUSE	COST	"LESSONS LEARNED"/ RECOMMENDED CORRECTIVE ACTIONS
08/25/83	Fire occurred at Building 1268A. Fire ignited on roof; no personnel injury and minor facility damage.	Contractor roofing activity involving burning operation.	$3K	• Fire watches provided for longer than 1 hour where risk determines need. • Building security system modified to provide more effective means of access to fire fighters.
09/01/83	Insulation material burned during demolition. Damage resulted from fire fighting effort.	Insulation contacted hot surface (electric light).	$1K	• Construction contractors cautioned regarding sources of ignition.
10/06/83	During proof test of Space Shuttle Main Engine (SSME) combustor, the liner was destroyed. No damage to combustor.	Overpressurization due to faulty K bottle regulation.	$20K	• Improve/enforce operational controls and procedures.

1983 NON NASA MISHAPS RELATED TO NASA OPERATIONS

DATE	DESCRIPTION	CAUSE	COST	"LESSONS LEARNED"/ RECOMMENDED CORRECTIVE ACTIONS
08/10/83	Subcontractor worker in building being refurbished for Solid Rocket Motor (SRM) processing was performing welding operations while suspended about 30 feet in a "Lift Basket/ Cage" attached to overhead hoist above degreaser vat of METHYL CHLOROFORM at elevated temperature. His clothing ignited and he fell in vat.	Confined space entry procedures and operation controls violated, cage was open on one side, and degreaser was flammable when believed not. Welding arc ignited a combustible mixture of METHYL CHLOROFORM and air-solvent contained an inhibitor, approx. 12% by volume, mostly flammables (1, 4 DIOXANE; NITRO-METHANE; 1, 1 DICHLOROETHYLENE). The DICHLOROETHYLENE content was increased by the nickel in the welding rod acting as a catalyst.	Fatality	• Enforce confined space entry procedures and operational controls. • Determine environmental constraints around welding operations and assure non-flammable atmosphere.
10/07/83	Two subcontractors installing conduit for security system modification accidentally struck 13.8kV line with conduit, sustaining electrical shock and burns.	Carelessness.	Both treated and released	• Avoid complacency. • Follow procedures.

NASA 1983 MOTOR VEHICLE INCIDENTS

DESCRIPTION	COST
While stopping, private, semi-truck jackknifed into Federal 4-door sedan at traffic light off-site.	$2,500
Vehicle struck by private auto.	1,457
Vehicle struck private auto; front end damage.	1,142
Federal stake body truck backed into stopped Federal van on-site.	700
Contractor operated vehicle struck post; operator had visual impairment.	672
Old GSA vehicles rehabed and sold to public; NASA charged for two vehicle rehabs.	403
Vehicle struck post; damaged right front bumper and post.	360
Vehicle struck wall; damaged right front nose panel.	360
Vehicle backing out of parking space; struck car passing behind.	260
Employee on travel in Florida; backed rental car into restaurant railing.	250
Vehicle struck by private auto; damaged door and side of truck bed.	202
Employee on travel; vehicle damaged in Los Angeles.	183
One Federal vehicle backed into another; hood and grill damage.	166
One Federal vehicle struck another; rear bumper damage.	122
Employee on travel in Florida; rental car struck by truck.	100
Employee on travel in Florida; rental car struck car coming from behind bus.	100
Employee on travel in California; rental car struck by another car.	100
Employee on travel in private auto; stopped for vehicle to make left turn and was struck by dump truck.	N/A

LOST TIME INJURY/ILLNESS BRIEFS
1983
(GOVERNMENT EMPLOYEES)

DAYS	DESCRIPTION OF MISHAP
92	Exposure to ceramic dust; severe dermatitis.
88	Struck by closing elevator door; fractured hip.
83	Due to a slip and fall; broken ribs and fractured vertebrae.
67	Privately-owned vehicle hit in rear after coming to a stop; back injuries.
63	Two employees collided; fractured left wrist.
46	Removing manhole cover by hand; strained back.
39	Moved a water pump; left inguinal hernia.
32	Walking down incline, foot slipped; fractured left fibula.
32	Removing paper from Xerox machine, hit back on corner of table; back spasms and numbness in left leg.
32	Walking from car to office, stumbled on rocks and fell; fractured elbow.
29	Slipped on object on floor; fractured kneecap.
29	Elevator not level with floor, tripped and fell into it; fractured left ankle.
28	Employee tripped and fell; experienced pain in legs (disc related).
26	Fell off a flatbed truck; injuries sustained.
24	Fell into drainage ditch; injured right leg below knee.
23	Slipped while climbing on a liquid nitrogen vaporizer; strain, lower back.
21	Fell from desk; sprained right knee.
20	Chair rolled over electrical outlet, employee fell backwards and hit head; contusion cervical region.
19	Fell on grass covered ramp; injured knee.
19	Employee fell; twisted ankle.

17	Using a wrench; strained back.
16	Chair carriage broke; employee injured back after falling to floor.
16	Tripped on stairs; injured back.
15	Removing sheet metal from power shear; amputation, left fingertips.
14	Attempting to lift pump; strained back.
14	Slipped and tried to prevent fall; injured back.
14	Fell while walking down stairs; possible concussion.
13	Picking up material at warehouse, slipped on wet floor; knee sprain eventually requiring surgery.
13	Moved a large metal frame across the floor; strain, lower back.
13	Lifting handrails; strained back.
12	Worked in a cramped position; muscle spasm, left cervical area.
12	Lifting material while in an awkward position; severe lumbar strain.
12	Installing skins on a core model; severe lumbar strain.
12	Moving desk; lacerated finger.
11	Caught thumb in door handle; sprain, right thumb.
10	Fell from forklift; sprained ankle.
9	While performing routine assignments, employee slipped on oil spot; injured left arm and right index finger.
9	Fell off ladder; injured knee.
9	Twisted ankle in parking lot; sprained ankle.
9	Injuries in an auto accident; sprain, neck and back.
8	Fell off chair; broken rib.
8	Cutting a circular piece of ½" flat bar on a band saw, was distracted and lost concentration; laceration of index finger right hand.
8	Tripped, fell in the office; broke two bones in left foot.

7	Slipped on ice in parking lot; fractured wrist.
7	Walking up stairs, felt something pull in right hip; sciatic neuritis.
7	Taking a walk, stepped in hole in lawn; fracture right ankle.
7	Bumped back against pipe while descending a ladder; contusion, right lower back.
6	Injuries sustained in auto accident.
6	Sitting at computer terminal, got up and stepped sideways; twisted leg, knee problem.
6	Stepping from the test cabin, stepped on the edge of roll around carriage; sprained right foot.
6	Lifting equipment from boxes; strain, lower back.
6	Dropped a piece of piping from shelf to foot; fracture, left toes.
5	Slipped and fell on pavement; back injuries.
5	Lifting box; strained back.
5	Lifting box; inguinal hernia.
5	Leaned against table, table collapsed with employee on top of it, both fell to floor; injured right hip.
4	Fell on wet steps; contusion of left rib cage.
4	While reaching for a hydraulic socket, employee jammed finger on a steel channel piece; broken left little finger.
4	Helicopter jack hit arm during the lifting process.
4	Moving rotor blade boxes inside of aircraft; injured lower back.
4	Slipped and fell, hit back on desk; contusion right lumbar area.
4	Working in elevator; twisted knee.
4	Walked into a pushcart in aisle; edematous, left leg.
3	Working inside tunnel nacelle, twisted; knee injury eventually requiring surgery.
3	Fainting spell in parking lot.

3	Walking down steps, slipped, fell; sprained ankle.
2	Leaned over printer, lid fell and hit on bridge of nose; cut on nose.
2	Walking up stairs, fell; hurt knee.
2	Bumped knee on desk drawer corner; contusion of left knee.
2	Walked through area where ceiling tiles were being removed; foreign body in eye.
2	Typewriter shelf popped up, catching fingers; laceration, left fingers.
2	Turned too quickly, ran into door frame; fractured right hand.
2	Tripped on sloped area of sidewalk; abrasions/contusions to face, elbows, knees and hands.
2	Struck eye with folder while filing; abrasion, right eye.
2	Slipped on ice in parking lot; lumbar strain.
1	After welding; foreign body in eye.
1	While crowding into elevator; closing door bruised arm.
1	Tripped over an electrical outlet; hurt knee and thigh.
1	Opening boxes with a knife, it slipped; cut hand.
1	Tried to stand up, foot was asleep, fell; sprained right ankle.
1	Soldered wires on an instrument panel; irritation, both eyes.
1	Working under a wooden plank, plank fell; contusion, top of head.
1	Stubbed toe; contusion, left great toe.
1	Twisted back while putting cable down; strain, lower back.
1	CPR course techniques while on knees; strain, both knees.
1	Tripped on typewriter cord; contusion to left buttock.

LOST TIME INJURY/ILLNESS BRIEFS
1983
(CONTRACTOR EMPLOYEES)

DAYS	DESCRIPTION OF MISHAP
143	Receiving parts at tool crib, fell; contusion left hip and right lower ribs.
127	Descending scaffolding; back sprain.
89	Lifted panel weighing 100 lbs. while stepping over a welding machine; back injury.
81	Unloading equipment from van; strained back.
70	Descending ladder, missed rung; pulled muscle lower back.
63	Shirt caught in rotating machine; injured arm.
60	Employee felt pop in knee upon standing up; sprained knee.
60	Inspecting damper on boiler, fell off 12' ladder onto a concrete floor; broken arm and compression fracture of T-11 vertebrae.
58	Moving barrels from pickup truck to building; back injury.
55	Lifting; back pain.
53	Descending fixed vertical ladder, slipped on the bottom rung; back injury.
52	Emptying trash; strained back.
50	Climbing scaffold, lost balance, fell; hernia.
47	Bending to secure vacuum cover; injury back.
47	Dropped box on upper thigh; internal injury to leg.
45	Slipped on wet floor; lower spine injury.
43	Lifting boxes and transferring them to another employee; acute epididymitis, lower right quad.
43	Lifted box; pain in groin area.
43	Strained lower back.
42	Employee dropped full trash can on knee; fractured knee.

41	Loading paper into printer; strained back.
40	Catching a carrier panel; strained shoulder.
39	Loading commercial vacuum; surgery for hernia required.
39	Climbing 50 foot ladder; strained back.
38	Slipped; tore cartilage in right knee.
38	Stood up; tore medial meniscal of knee, surgery required.
37	Right leg caught in structure support beams; twisted right knee.
37	Picked up compressor; strained lower back.
36	Entering building, gusty winds caught door, fell, struck chest on cement parking stop; fractured ribs and punctured leg.
36	Bent over to pick up something from floor; hernia.
35	Pulling electrical cable from ceiling, fell from ladder; fractured skull.
35	Slipped in a puddle of water; fractured vertebrae.
33	Muscle spasms in back.
33	Slipped while ascending ladder; dislocation of sterno-clavicle bone.
32	Bent to roll out roofing paper; muscle spasm lower back.
32	Inhalation of toxic fumes.
32	Emptying trash; strained back.
31	Slipped and fell; injured left hip.
30	Fell while carrying heavy object; contusion of left knee.
30	While handling grass sods; strained lower back.
30	Hernia.
30	Automobile accident; cervical spine injury.
20	Unrestrained seat in government vehicle moved forward; previous neck injury aggravated.
28	Slipped on oil; dislocated left shoulder.

28	Lifting and carrying tunnel covers and seals; pain in lower back.
27	Blending chemicals for a smoke pot improvement program, blender exploded; avulsions, abrasions, lacerations, and chemical burns.
26	Squatting to enter Orbiter; torn knee tissue.
26	Bent over box, raised up; hit head on wooden pallet.
25	Walking in parking lot in heavy rainfall, stepped on a slippery spot, fell; hit left knee, right elbow, and back.
24	Slipped and fell; broken ribs.
23	Turning desk over; hernia.
23	Lifting power saw; strained neck and back muscles.
22	Pulling mail boxes up stairs with dolly, felt something pop in back; back injury.
21	Toxic inhalation exposure.
21	Fall; right hip contusion.
21	Ladder slipped, fell from ladder; lumbar strain.
21	Walking across maintenance yard, fell into rocks; broken bone in wrist.
20	Operating vise in test cell; strained lower back.
20	Door panels being painted; fell on foot.
20	Ran foot under mail cart; cuneiform diastasis.
19	Pulling on a large structure mounted on casters, right foot slipped; caster rolled over toes.
19	Detorquing bolts all day; protrusion of right groin.
18	Unbalanced blade tip fell; fracture, left ankle.
18	Exiting trailer; slipped and fell on back.
18	Using cutting torch without gloves; third degree burns, top right hand.
17	Bent to fill fuel tank; sprain, lower back.
17	Moving boxes; because of chronic pre-existing condition, back, leg, and ankle pain.

17	Lifting heavy object; strained neck, back, and right shoulder.
16	Struck by tongue of generator unit; fractured foot.
16	Slipped on power cable; twisted right knee.
16	Moving box; strained back.
15	Violent bucking of transporter caused back injury.
15	Stepped backwards out of truck on uneven concrete; broken ankle.
15	Puncture wound, left leg.
15	While sitting in chair, turned and injured back; severe lumbo thoraco strain.
15	Opened double door; acute lumbar joint strain.
15	Placing catalogue on shelf; pulled muscle and ligament in shoulder area.
14	Picking up trash cart; strained back.
14	Walking to vehicle to go to work site; sprained left ankle.
14	Slipped and fell on ice.
14	Lifting a box; pain in back.
14	Struck by a panel from transformer; fractured right clavicle.
14	Picking up empty carrier panel; injured back.
12	Lifting vertical lockbar to open gate; strained back.
12	Pulling jack; strained shoulder.
12	Employee fell on wet floor; injured arm.
11	Carrying large boxes; pulled neck muscle.
11	Dropped manhole cover on foot; broke great left toe.
10	Picking up boxes of paper; sprained right wrist.
10	Removing safety valve with wrench; strained back.
10	Off-loading equipment from a forklift, placed foot beneath fork while it was being lowered; fractured two toes.

10	Directing traffic; twisted right knee.
10	Lifting batteries; felt pop in lower abdomen.
10	Slipped; tore cartilage in left knee.
10	Missed chair, fell; pain in tailbone.
10	Dumpster rolled into worker; bruised ribs.
9	Diving in WETF; outer and inner ear infection.
9	Getting out of truck; pain in back. (Pre-existing condition.)
9	Bending to pick up trash; muscle strain.
9	Slipped and fell; back strain.
9	Slipped and fell; back strain.
9	Slipped and fell; back strain.
9	Stood up, hitting head on drawer; concussion.
9	Door closed on finger; smashed finger.
8	Bending, pulling out, and pushing in files and cabinets; lumbar sprain.
8	Sliver of white bostic paint embedded in index finger of right hand.
8	Automobile accident; lacerations and contusions to shin, neck, and left arm.
8	Contacted electrical supply; shoulder, neck, face, and ear burns.
7	Setting down equipment; pulled back muscle.
7	Stepping off truck; pulled back muscle.
7	Fell from loading platform; injured right wrist, contusion of head, and cervical strain.
7	Working in awkward position; soreness in back.
7	Wheel fell on left big toe; contusion.
7	Chair caught in hole, fell; strained back.
7	Fell on steps; soft tissue injury to buttocks, right side.

7	Lifting magnetic tapes; lower back injury.
7	Insect bite (spider) while handling material in salvage yard.
6	Motorcycle accident; bruised ribs, legs, and right arm.
6	Jumped from catwalk; derangement of right knee meniscus.
6	Bumped knee while climbing up on table; knee injury.
6	Exiting from truck cab, stepped on rocky surface; twisted and fractured ankle.
6	Holding end section of air conditioning condensor in place to align bolt holes, bolt that was being placed slipped, and as attempted to catch condensor fell; left side of head and shoulder badly bruised.
6	Insect bite; phlebitis left leg.
6	Spray cleaner in eye.
6	Slipped and fell; fractured patella (knee cap).
6	Trying to open window; contusion to fingers on left hand.
6	Slipped and fell; cracked bone in left heel.
6	Lifting tub of mail; back strain.
6	Slipped on oil spill; sprain, right shoulder.
6	Exiting partially open door; bruised leg and muscle spasm.
6	Blending chemicals for a smoke pot improvement program, blender exploded; avulsions, abrasions, lacerations, and chemical burns.
6	Struck by automobile while directing traffic; contusion to leg.
6	Installing filter assembly, awkward position; strained shoulder.
5	Fell backwards while descending from table to step stool, struck head on chair; severe contusion of left lumbar area.
5	Lifted 60 lb. can of water and poured into vat; strained back.
5	Trying to free vehicle from the mud, it rolled back; struck left knee.

5	Stringing cable through cable trays; strained muscle in back.
5	Stepped on cinder block on stair landing, turned ankle, fell down stairs; sprained ankle.
5	Climbing stairs; back pain.
5	Lifting; sharp pain in back.
5	Stepping off truck; pain in leg and spine.
5	Hit by cable; infection to right shin.
5	Motorcycle rider struck by front of a vehicle; bruises.
5	Dropped gear cover on hand; contusion (tendon bruised), right little finger.
4	Bitten by black widow spider; venom injection.
4	Moving panel; strained back.
4	Moving equipment; strained back.
4	Lifting roll of roofing felt, grabbed section of roof; sprained back.
4	Departing from a tug; sprained left leg.
4	Picking up box of paper to put in computer printer; injured back.
4	Lifting box; refracture of a previous injury.
4	Lifting; pain in back.
4	Received electrical shock from coffee pot.
4	Removing ants from building, slipped; injured ankle.
4	Fell from trailer; head abrasions and fractured both wrists.
4	Dropped steel plate on foot; acute contusion of right foot.
4	Closed sliding van door on hand; severe hand sprain.
4	Lifting heavy tool box; shoulder injury, muscle spasm, and pinched nerve.
4	Stepped out of van; sprained left foot.
4	Pulling cable through ceiling; strained lower back.

4	Slipped on sand while removing timber from barge dock; strained knee.
3	Lifting heavy bucket; strained back.
3	Installing communications circuit, hit head on top of door casing when turning to leave; slight concussion.
3	Slipped on oily surface, fell, hit head on steel floor; laceration and contusion of forehead and face, fractured nose.
3	Fell down steps; sprained knee.
3	Hit head against tape deck door.
3	Moving maintenance stand; mashed two fingers on left hand.
3	Checking outside of building; stung on the back of neck by wasp.
3	Moving old batteries from basement area up a flight of steps to the outside; back injury.
3	Removing recorder from a rack; injured back.
3	Turning around; pulled ligament in right ankle.
3	Trying to stop a falling object; fractured hand.
3	Pulling cart; sprained right heel.
3	Fell into improperly covered drain/sump; injured left leg.
3	Slipped in gravel parking lot; sprained ankle.
3	Ankle struck structural steel; fell.
3	Sand blast cover lug nut hit worker in the eye.
3	Standing up; sprained knee.
3	Hit forehead on file drawer.
3	Slipped on wet floor; strained back.
2	Pushing barrels; lower back pain.
2	Stepped into open pit; minor left knee lacerations.
2	Magnetic tape reel fell on toe.
2	Slipped and fell on floor; sprained ankle.

2	Checking crane, a compartment door fell and struck head; superficial cut on scalp.
2	Pulling furniture dolly loaded with computer paper up a flight of stairs, dolly began to tip, reached to stop it; injury to lower back.
2	Walking through building; twisted right knee.
2	Lifting boxes from floor to table; lower back strain.
2	Ascending ladder, struck head on protruding pipe; cervical sprain.
2	Removing trash; cut left thumb on broken cup concealed in trash.
2	Descending stairs, missed step, fell; fractured left foot.
2	Lifting heavy bag of trash; strained back.
2	Fell down stairs; injury to legs, arms, and back.
2	Pulled muscle in right shoulder.
2	Twisted right ankle.
2	Tape filing cabinet fell on employee.
2	Slipped and fell; injury to knee.
2	Lifting; pain in upper back.
2	Descending stairs; strained right calf muscle.
2	Stepping off ladder onto aluminum frame laying on floor; twisted ankle.
2	Slicing meat; amputated end of index finger.
2	Foot slipped off clutch; sprained ankle (previous injury)
2	Pulling cargo tiedown rope; hit elbow on truck.
2	Slipped and fell; unconscious.
2	Cutting tape off cardboard box; cut finger.
2	Taking hoses off shelf; back sprain.
2	Bending over; strained back.
2	Unloading case of paint; back pain.

2	Slipped on gravel; twisted knee.
2	Normal lifting; sprain to lower back.
2	Pulling tub of mail out of shelf; sprained right shoulder.
2	Lifting a 2"x6"x16' board; lower back strain.
2	Ascending stairs, tripped and fell; fractured bone in leg.
2	Slipped while directing traffic in rain; strained right knee.
2	Cleaning stairwell; sprained right toe.
2	Pulling cables through cable rack, one snagged, came loose, struck forehead; laceration and contusion of upper forehead.
1	Moving 15 flight tapes between buildings; irritated recurring back injury.
1	Pulling large monkey cage, collided with steel support pole; smashed left hand.
1	Transporting lumber on rollaway cart, board fell off cart, struck left foot; pain in metatarsal area of left foot.
1	Stepped off ramp; sprained ankle.
1	Working on brake system for CV-990 aircraft, a line carrying brake fluid ruptured and sprayed fluid into eyes; skydrol fluid in eyes.
1	Lifting walkover cover; strained back.
1	Leaking exhaust pipe; severe headaches caused by carbon monoxide.
1	Welding rod fell on left foot.
1	Removing blank flange on Kemp Dryer with air gun, air hose broke loose in hand while descending ladder; turned ankle.
1	Fell off truck tailgate; sprained back.
1	Stepped into open floor hole; sprained knee.
1	Lifting box; fell off ladder.
1	Fell down steps.
1	Walked into metal pole.
1	Shot hand with nail gun.

1	Drawer fell on knee.
1	Struck head against equipment.
1	Dust in eye.
1	Holding item being arc-welded; arc flash burn to eyes.
1	Bruised left toe.
1	Muscle strain right back.
1	Lifting boxes of paper; lower back pain.
1	Fell off step ladder; contusions to both lower legs.
1	Fell on stairs; injury to waist.
1	Driving motor vehicle, hit large hole between railroad tracks; wrenched neck and fractured dentures.
1	In T-38 boattail, awkward position; strained left leg.
1	Kneeling on floor to secure electronic cable; sprained knee muscles.
1	Using exacto knife; cut hand.
1	Carrying baggage and training materials at airport; strained back muscles.
1	Caught finger between pipe wrenches; contusion/laceration of left middle finger.
1	Working with tar pot, hot tar splashed; 1st and 2nd degree burns to left forearm.
1	Walked into wall; cut and bruised forehead.
1	Entering door, threshold plate slipped; twisted right ankle.
1	Lost balance while walking; twisted left ankle.
1	Stepped on the edge of black top road having four inch drop; turned ankle, hairline fracture.
1	Arc welding, arc reflected off adjacent wall; flash burn to left eye.
1	Pulling pipes from a pipe rack; cartilage injury to rib cage.
1	Slipped on stairs: twisted left ankle.

1	Moving chair; pulled lower back muscles.
1	Slipped; twisted back.
1	Lifting 50-60 lb. boxes; injured back.
1	Bitten by fire ants while weeding.
1	Lifting pipe; strained back.
1	Excessive GN_2 used in a grease spraying operation; inhalation problems.
1	Blowing metal chips with air; metal chips in eyes.
1	Using exacto knife; cut left wrist.
1	Lifted a pan of gravy; twisted back.
1	Walked into overhead valve wheel; head contusion and sprain of cervical spine.
1	Lifting box of paper; back sprain.
1	Debris in eye; scratched right eye.
1	Contacted poison ivy.
1	Dropped object on foot; bruised right foot.
1	Slipped and fell, poor weather conditions; bruised left knee.
1	Walked into object protruding into walkway; bruised right side of torso.
1	Lost balance and fell; fracture and torn ligaments, left thumb.
1	Drill motor started during adjustment of bit; laceration, head.
1	Slipped on liquid methane spill; sprain, right knee and ankle.
1	Slipped and fell from 5-foot ladder; bruised ribs.
1	Lifting a portable generator; groin muscle injury.

PERSONNEL AND TRAINING

Each NASA center maintains a staff of safety personnel. The numbers at each facility are shown in Table 9. This table is followed by a list of all safety related training courses and programs sponsored by the different centers during 1983.

TABLE 9. NASA SAFETY PERSONNEL BY FACILITY

	Safety Professionals (Full-Time)				Facility Safety Reps. Safety Coordinators (Part-Time)				Contracted Safety Support (Full-Time)			
	OCCUPATIONAL	FIRE PROTECTION	SYSTEMS SAFETY	AVIATION SAFETY	OCCUPATIONAL SAFETY	FIRE PROTECTION	SYSTEMS SAFETY	AVIATION SAFETY	OCCUPATIONAL SAFETY	FIRE PROTECTION	SYSTEMS SAFETY	AVIATION SAFETY
ARC	4.5	1	2	2.4	70	1	1	1	5	1	6	0
GSFC	11	1	0	0	54	0	0	0	5	0	0	0
HQ	2	1	8	4	0	0	0	0	0	0	0	0
JSC	9	1	16	1	135	70	1	0	12	15	51	0
KSC	25	2	12	1	0	0	0	0	3	42	6	0
LaRC	5	1	3	0.5	150	50	150	15	3	26	4	0
LeRC	7	0	0	1	24	7	90	5	0	0	0	0
MSFC	11		9	0	162	0	0	1	0	0	0	0
NTSL	1	0	0	1	0	0	0	0	3	1	1	0

TRAINING COURSES AND PROGRAMS BY CENTER - 1983

AMES RESEARCH CENTER

Categories: A - Safety Professionals and Safety Support Groups
B - Equipment Operators and Front Line Workers
C - Uncategorized

COURSE TITLE	LENGTH (HOURS)	NUMBER ATTENDING A	B	C
Systems Safety Workshop		83		
Radiation Safety (X-Ray, X-Ray Diffraction)		6		
Radioisotope Safety (Authorized Users)		20		
Radioisotope Safety (Workers)		35		
Laser Safety		128		
Microwave Safety		24		
Forklift Safety			25	
Crane Safety			16	
High Pressure Safety			40	
Respiratory Protection			40	
Fire Protection & Extinguisher Use		75	300	
OSHA Construction		50		
Electrical Safety			11	
First Aid		6	30	
CPR		29	140	
Accident Investigation		6		
Lab Safety		95		
Explosives			7	
PCB Handling			1	
Electrostatic Discharge		2		
Shuttle Area Safety		7		
QA Audit Techniques; Commercial, Government and Nuclear		4		

TRAINING COURSES AND PROGRAMS BY CENTER - 1983 (cont.)

DRYDEN FLIGHT RESEARCH FACILITY

Categories: A - Safety Professionals and Safety Support Groups

B - Equipment Operators and Front Line Workers

C - Uncategorized

COURSE TITLE	LENGTH (HOURS)	NUMBER ATTENDING A	B	C
Power-Actuated Tools Safety (Serve-Air - contractor)			25	
Hi-Ranger Certification (Serve-Air - contractor)			4	
Shuttle Area Hazardous Waste Handling Certification		4		
Shuttle Area Safety Training (Certification and Recertification)			748	
Electrostatic Discharge Training			57	
Certification of Persons to Remove and Store Pyro's Removed from Shuttle		2		

TRAINING COURSES AND PROGRAMS BY CENTER - 1983 (cont.)

GODDARD SPACE FLIGHT CENTER

Categories: A - Safety Professionals and Safety Support Groups
B - Equipment Operators and Front Line Workers
C - Uncategorized

COURSE TITLE	LENGTH (HOURS)	NUMBER ATTENDING A	B	C
Audio Sensory Testing	40	1		
Auto Extrication (Refresher)	2	12		
FOM* Duties and Responsibilities	8	43		
Compressed Gases and Cryogenic Safety	4	3	80	
Hearing Conservation	1		78	
Industrial Accidents	6		21	
Safe Handling of Electro-explosive Devices	8	3	28	
EMT Refresher Course	40	1		
Hypothermia, Environmental Injuries	8		11	
Hazardous Chemical Safety	16	6	71	
Hazardous Materials (OSHA 600-10A)	40	2		
Protective Breathing Apparatus	8		27	
Cardiopulmonary Resuscitation (CPR)	8	12	279	
CPR (Refresher-Health Unit Personnel)	4	12		
CPR Instructors Training	16		10	
Standard First Aid	8		60	
KSC Safety Orientation	6		19	
Fire Extinguisher Training	4	63	248	
Fork Lift Operator Safety	8		3	
Emergency Equipment (Refresher)	4	12		
Luncheon with the Doctor	1	4	36	
Supervisor Safety Orientation	1		16	

*Facility Operations Manager

TRAINING COURSES AND PROGRAMS BY CENTER - 1983 (cont.)

JOHNSON SPACE CENTER

Categories: A - Safety Professionals and Safety Support Groups
B - Equipment Operators and Front Line Workers
C - Uncategorized

COURSE TITLE	LENGTH (HOURS)	NUMBER ATTENDING A	B	C
NASA MORT-Based Accident Investigation Workshop	80	20		
Hazardous Chemical Workshop	16	85		
Hazardous Chemical Transportation	16	2		
Supervising for Safety	32	2		
Fire Training	1.5			850
Fire Warden Training	1			1
Astronaut Fire Training	2.5			19
Visitor Safety	1.5			14
Pre-Fire Training	1.5			32
Laboratory Safety and Health	8	2		
How to Avoid Back Injuries	8	1		
System Safety Conference	24	4		
Texas/Southwestern Safety Conference	24	4		

TRAINING COURSES AND PROGRAMS BY CENTER - 1983 (cont.)

KENNEDY SPACE CENTER

Categories: A - Safety Professionals and Safety Support Groups
B - Equipment Operators and Front Line Workers
C - Uncategorized

COURSE TITLE	LENGTH (HOURS)	NUMBER ATTENDING A	B	C
Toxic Prop. Refresher and Breathing Escape			1,883	
Fire Protection Safety Orientation			3,645	
Toxic Propellant Safety			1,683	
Tank and Confined Space Entry			190	
Toxic Propellant Refresher			1,701	
Titan ITL Safety Orientation			448	
LC-17 Area Familiarization			460	
LC-39 Area Familiarization			1,170	
Pad Safety Familiarization			1,211	
KSC Industrial Area Familiarization			968	
Area 60A and 39 Safety Familiarization			473	
LC-36 Complex Orientation			427	
Flight Vehicle Safety			1,033	
Liquid Propellant Storage Area			407	
SRB Safety and Egress			968	
High Pressure Gas Safety			242	
AF Hangar Orientation			276	
Clean Room Entry			236	
Contingency Crew Fire Fighting			730	
Two Way Radio and OIS Familiarization			189	
Area Familiarization Crafts and Trade Prsnl			326	
First Aid for Electrical Shock			505	
Single Rescuer CPR (Heart Saver)			680	
Emergency Egress Com 39 Pad A&B			414	
Scott/Survive Air Pack Training			140	
Crane Operator Training			116	
Spt and Self Contained Resp. Tank & CE			231	

TRAINING COURSES AND PROGRAMS BY CENTER - 1983 (cont.)

KENNEDY SPACE CENTER (cont.)

Categories: A - Safety Professionals and Safety Support Groups
B - Equipment Operators and Front Line Workers
C - Uncategorized

COURSE TITLE	LENGTH (HOURS)	NUMBER ATTENDING A	B	C
SCAPE Operator Certification			252	
SCAPE Operator Recertification			79	
Flight Crew Land Rescue			30	
Flight Crew Pad Rescue			37	
Flight Crew Landing Site Rescue			24	
Cat. IV & VI SCAPE Operator Certification			230	
Cat. IV & VI SCAPE Operator Recertification			60	
SCAPE Operator Recertification			18	
Spider Operator Certification			16	
Minor Hydrazine Spill Clean-Up			35	
Handling of Chemicals in Lab		47		

TRAINING COURSES AND PROGRAMS BY CENTER - 1983 (cont.)

LANGLEY RESEARCH CENTER

Categories: A - Safety Professionals and Safety Support Groups
B - Equipment Operators and Front Line Workers
C - Uncategorized

COURSE TITLE	LENGTH (HOURS)	NUMBER ATTENDING A	B	C
NFPA Training	32	1		
Self Contained Breathing Apparatus Seminar	6	1		
Pressure Vessel Safety	6	5		
Construction Safety Standards	32	1		
Basic Radiological Health	8	2		
Hazardous Chemical Course	16	6		
Reliability Design	32	1		
Accident Investigation	80	2		
Senior Management Safety Training	4	3		
Alterations and Repairs/Boilers and Pressure Vessels	32	1		
Annual NASA Safety Directors Conference	32	3		
Annual Health Physics Conference	32	1		
Safety Orientation	87			87
Lifting Policies and Procedures	40			125
Safety Training (New Supervisors)	1			28
Safety Operators	4			60
Constructions Contractor Briefing	0.5			203
Hazardous Chemical Course	16			83
Chemical Safety Orientation	1			20
Radiography	1			3
Laser Safety Training	3			41
Ionizing Radiation	9			9
Confined Space	1			66
Respirator Use	1			65
PCB Hazards	2			33
Hearing Conservation	1			219

TRAINING COURSES AND PROGRAMS BY CENTER - 1983 (cont.)

LANGLEY RESEARCH CENTER (cont.)

Categories: A - Safety Professionals and Safety Support Groups
B - Equipment Operators and Front Line Workers
C - Uncategorized

COURSE TITLE	LENGTH (HOURS)	NUMBER ATTENDING A	B	C
Asbestos	1			15
Red Tag Briefing	0.5			87
Explosion Hazards Evaluation	40			1
Safety (Apprentice School)	30			23
Hazardous Waste Management Conference	8			1
Industry and the Environment	8			2
Cardiopulmonary Resuscitation	7			17
Electrostatic Discharge Control	5			22
Thermoforming	16			1
Safe Handling of Compressed Gas	8			1
Pressure Vessel Safety	6			49
Senior Management Safety Training	4			18
Principles of Handling Liquid Atmospheric Gases	11			1
Avoiding Back Problems	1			22
Noise Seminar	3			1
Occupational and Community Noise Seminar	3			1
Shop Safety	1			127
Chemical Safety	61			61

TRAINING COURSES AND PROGRAMS BY CENTER - 1983 (cont.)

LEWIS RESEARCH CENTER

Categories: A - Safety Professionals and Safety Support Groups
B - Equipment Operators and Front Line Workers
C - Uncategorized

COURSE TITLE	LENGTH (HOURS)	NUMBER ATTENDING A	B	C
Accident Investigation				
Hazardous Materials				
Safety Training Methods				
New Employee Orientation				
Powered Industrial Touch Operation Safety				
Portable Fire Extinguisher Operation				
Air Pack Operation				
Cardiopulmonary Resuscitation				
Oil Spill Operations				
Evacuation Monitors				
Tagging Out				
Contract Administration				

TYPE A: Between 1-3 per course, a total of 6.

TYPE B: Between 9 and 255 per course, a total of 996.

TRAINING COURSES AND PROGRAMS BY CENTER - 1983 (cont.)

MARSHALL SPACE FLIGHT CENTER

Categories: A - Safety Professionals and Safety Support Groups
B - Equipment Operators and Front Line Workers
C - Uncategorized

COURSE TITLE	LENGTH (HOURS)	NUMBER ATTENDING A	B	C
OSHA Hazardous Materials Course		33		
NFPA Life Safety Code		31	3	
Building Survey and Supervision of Asbestos Training		2		
Fire Warden Training for the 4200 Building Complex		45		
Accident Investigation		1	2	
NSC Safety Training Methods		10		
J.T. Baker Hazardous Chemical Course		50	50	
Bomb Threat Training		150		
OSHA for the Federal Agencies		1		
Handling and Disposal of Hazardous Chemical Waste		2		
Respirator Protection Training			150	
National Safety Council Defensive Driving			50	
Handling Liquified Natural Gas			100	
Fire Extinguisher Refresher Training			100	
Cardiopulmonary Resuscitation Training			100	

TRAINING COURSES AND PROGRAMS BY CENTER - 1983 (cont.)

NATIONAL SPACE TECHNOLOGY LABORATORIES

Categories: A - Safety Professionals and Safety Support Groups
B - Equipment Operators and Front Line Workers
C - Uncategorized

COURSE TITLE	LENGTH (HOURS)	NUMBER ATTENDING A	B	C
OSHA Hazardous Materials		X		
National Safety Council Satellite Course for Prevention of Back Injury		X		
Radiological Safety		X		
NASA Accident Investigation (MORT)		X		
OSHA Hazardous Materials		X		
Comprehensive Industrial Hygiene Review		X		
Supervision of Asbestos Abatement Contracts		X		
Safety Management Seminar		X		
International Safety Academy Basic Safety Management		X		
Radiographic Safety		X		
College Safety		X		
Monthly Safety Meetings			40	
Annual Recertification			50	

* U.S. GOVERNMENT PRINTING OFFICE: 1984-461-599:53